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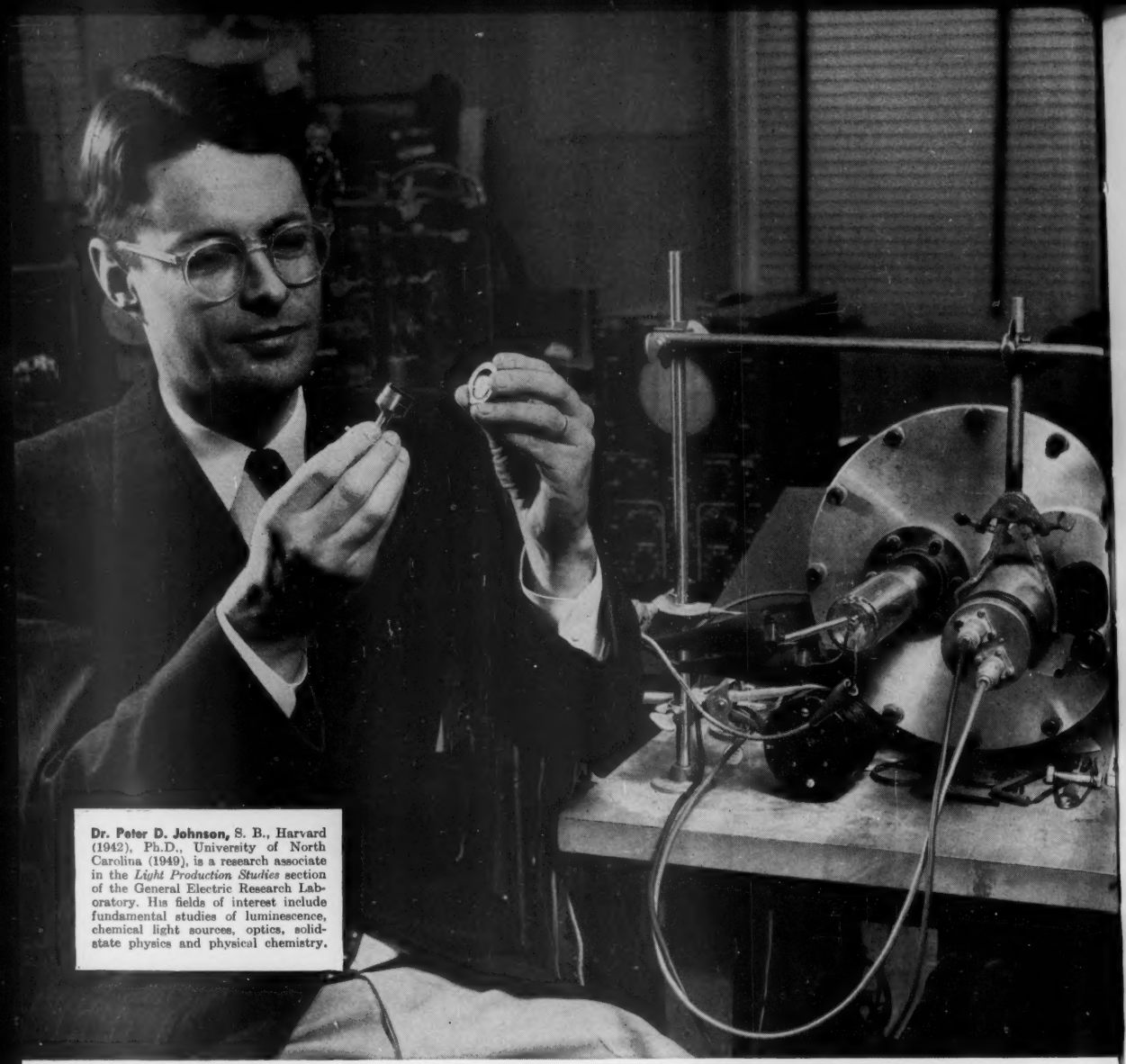
SCIENCE

7 September 1956

Volume 124, Number 3219

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Dr. Peter D. Johnson, S. B., Harvard (1942), Ph.D., University of North Carolina (1949), is a research associate in the *Light Production Studies* section of the General Electric Research Laboratory. His fields of interest include fundamental studies of luminescence, chemical light sources, optics, solid-state physics and physical chemistry.

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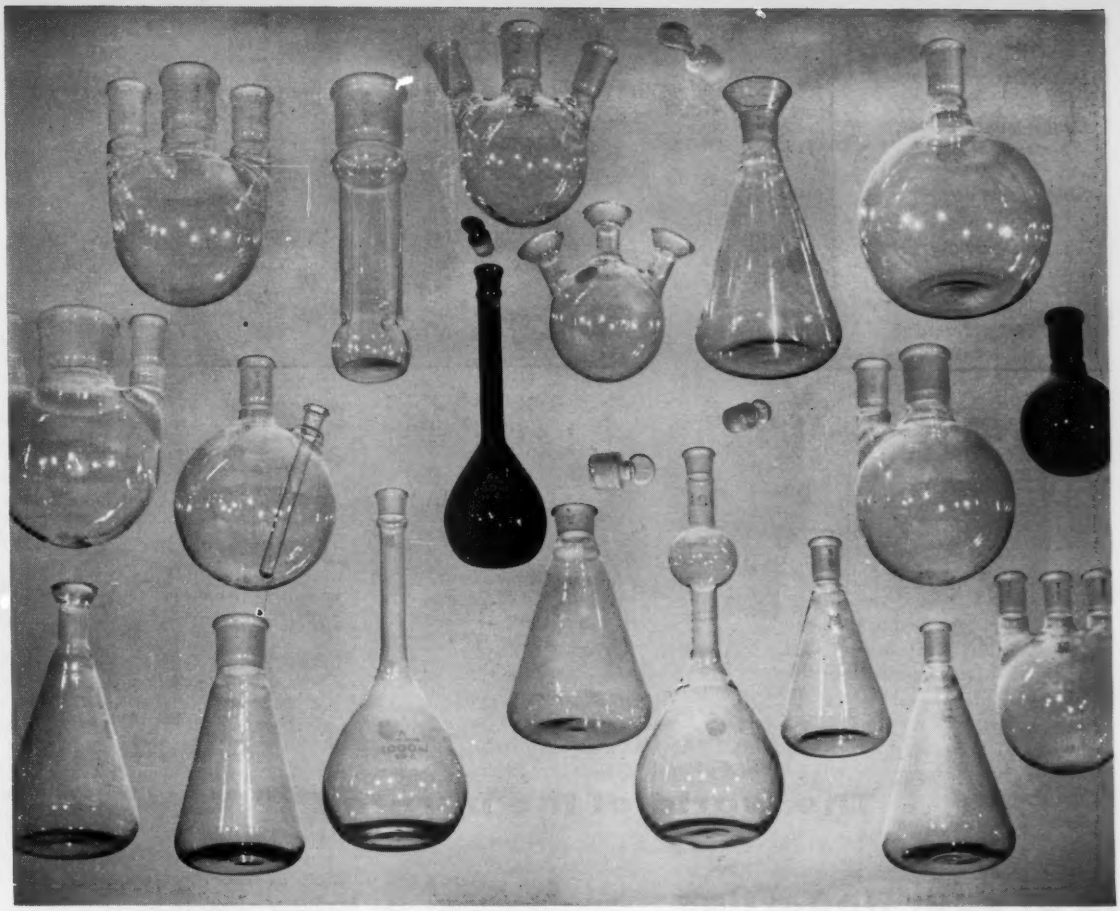

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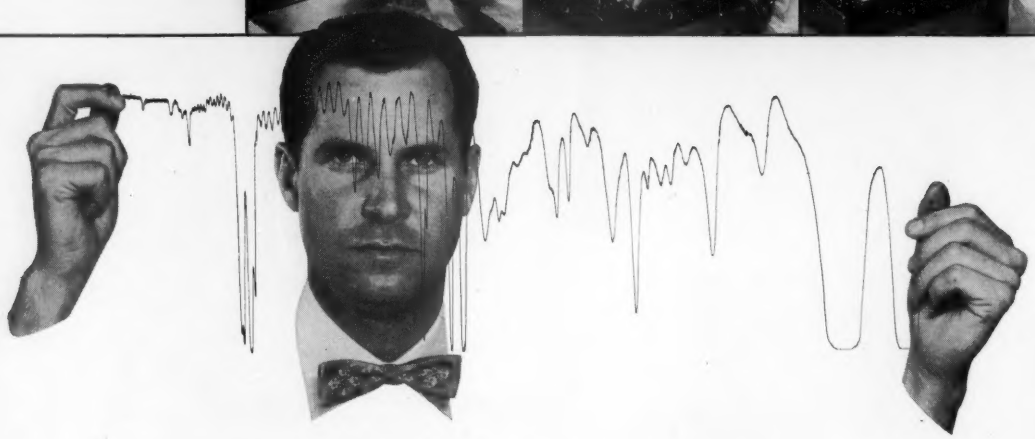

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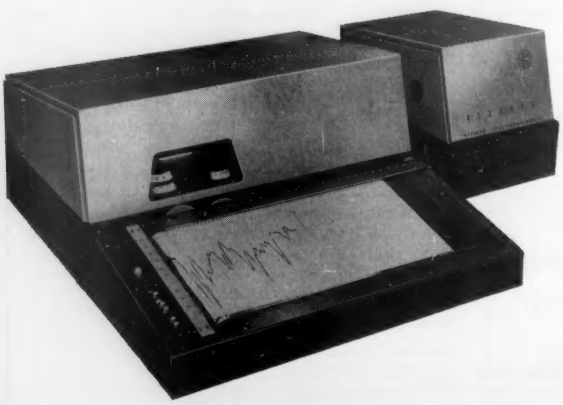

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SCIENCE

SCIENCE founded in 1880, is published each Friday by the American Association for the Advancement of Science at Business Press, Lancaster, Pa. Entered at the Lancaster, Pa., Post Office as second class matter under the Act of 3 March 1879.

SCIENCE is indexed in the *Reader's Guide to Periodical Literature* and in the *Industrial Arts Index*.

Editorial and personnel-placement correspondence should be addressed to SCIENCE, 1515 Massachusetts Ave., NW, Washington 5, D.C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors. For detailed suggestions on the preparation of manuscripts, book reviews, and illustrations, see *Science* 123, 714 (27 Apr. 1956).

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Research and Freedom

The *Sun*, Baltimore, had some pertinent remarks to make about the description a group of American physicists brought back from their visit to the U.S.S.R. this last spring. On 14 June the *Sun* remarked editorially:

"The reports of various members of this group on what they saw of Russian science are fascinating, and disconcerting. They are disconcerting for two reasons.

"First, they report that Russian science is flourishing, that the laboratories are beautifully equipped, that first quality personnel is abundant, that work of fundamental importance is being done, and that the Russians are not only bent on making Moscow the headquarters of the world so far as physics is concerned but may well succeed.

"That is disconcerting for obvious reasons. Still more disconcerting is the paradox which these reports expose. . . . In this country it is commonly stated by men of science and others that freedom is essential to a healthy scientific climate. The point has been made repeatedly in connection with criticisms of various Government security arrangements. And yet we learn now from well qualified American physicists that Russian science, which has surely had to put up with security arrangements more stringent than the American, is in a flourishing condition and that members of the Russian scientific community show evidence of the highest morale in their personal and scientific life.

"How is this to be explained? Oddly enough, the reports of these American scientific visitors to Russia have included no explanation. Is the maximum of freedom important to the health of science, or isn't it? Have we been wrong in supposing that Russian science is less free than American science? These travelers lately returned from Moscow owe the public a clear answer."

The editor of the *Sun* followed this up by asking Freeman Dyson of the Institute of Advanced Studies at Princeton to prepare an article about working conditions of scientists in the U.S.S.R., an article that we reprint in this issue (page 432). In the same issue of the *Sun* in which this appeared (26 June), the *Sun* had other editorial comments to make, from which we take the following excerpts:

"We welcome [Dyson's] article for several reasons. Not the least of these is the way he puts the Soviet achievements in science into perspective. Russian physics is good, he says, but not yet as good as American physics. And he attributes the Russian progress to the existence in the post-Stalin Russia of 'a reasonable scientific freedom. . . .'

"Yet Dr. Dyson goes on to say that security provisions in Russia 'are similar to ours, perhaps slightly stricter.' And he emphasizes that 'political freedom . . . does not exist in Russia.' Thus the paradox of scientific progress in an unfree society still wants an explanation.

"Men raised in the western tradition will hesitate to conclude that full intellectual freedom is perhaps a less urgent precondition of scientific progress than has been argued. On this point other scientists may wish to be heard. Surely the question is of compelling importance as the scientific race between free and totalitarian worlds gathers speed."

We agree that the questions the *Sun* raises editorially are of the first importance and we present them here for consideration by the scientific public.

Kodak reports to laboratories on:

how come we tout another manufacturer's camera . . . solvency and open windows from 2 to 16μ . . . coloring a mental image

Out on the ghostly curve

If called upon to explain how come the world's best known camera manufacturer spends money in this space to tout another manufacturer's camera, we would argue thus:

The new "Graphic 70" is a military combat camera now available to whoever can spend $1850. Doubtless $1850 hand-held still cameras are harder to sell to civilians than $1850 automobiles. On the other hand, Graflex, Inc., has built quite a camera there and has done so on a basis more solid than to satisfy an occasional whim for conspicuous consumption. The principle is that when a man is trying to get some useful pictures at grave risk to his life, a thousand dollars one way or the other is a small price to pay for mechanical and optical refinements that may boost his chance of success a percent or two. In nonmilitary affairs, where calculations happily involve only money instead of lives, situations are also encountered where good sense dictates a position very far out along the ghostly curve connecting quality of equipment with probability of success.

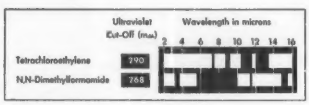
So Graflex builds a 5-pound camera to use our new faster, finer-grained films in the 70mm width that requires little enlargement. The most elaborate precautions are taken in controlling the geometrical relationship between the film and the lens. This is worth doing because of the lenses used on the "Graphic 70." They are the result of taking a generation to build up a strong organization in optical research, design, and manufacturing, then handing it the assignment to produce a 4-inch, an 8-inch, and a 2½-inch lens that will do the best job of putting down a 56mm by 72mm image that the current state of knowledge in optics permits.

And what does it say on the lenses? It says *Kodak Ektar*.

Those interested in the "Graphic 70" camera can learn more by writing Graflex, Inc., Consumer Correspondence Department, Rochester 8, N. Y. Those who wish they had an optical organization like ours to whom to hand design or manufacturing problems can write to Eastman Kodak Company, Apparatus & Optical Division, Rochester 4, N. Y.

Responsibility of the house

What (we hope) makes a liter of *Tetrachloroethylene* (Eastman S2418) or *N,N-Dimethylformamide* (Eastman S5870) worth $15.10 or $5.15 respectively is our word as a reputable house that these two new Spectro Solvents have the following open infrared windows and ultraviolet cut-offs:



The only reason why a person capable of doing infrared or ultraviolet spectrophotometric analysis shouldn't check and if necessary purify his own solvents is an economic one. If he cannot employ his time and talents at a higher level, perhaps his setup should be checked for something wrong.

Tetrachloroethylene (*stabilized with Thymol*) is added to our list of 15 Eastman Spectro Solvents because it closes three gaps—6.5-6.8μ, 7.9-8.3μ, and 13.4-14.2μ—in the infrared spectrum that is available to the worker who needs the solvency of chlorinated hydrocarbons. From 12.0 to 13.4μ, chlorinated-hydrocarbon darkness still prevails (but *Bromoform* (Eastman S45) suffers from little of this blackout).

N,N-Dimethylformamide is added because some organic chemists have regarded it from the days of youth as something of a universal solvent and would fain continue so even after involving themselves in the newer-fangled optical chemistry. This amide is even a good solvent for nylon and any other amide-type plastics you may have around. It is definitely more polar than benzene or acetone and may not be a bad bet for dissolving amides from protein hydrolysates. The low molecular weight helps build up the solute concentration percentage.

Free for the asking from Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y., is a chart showing the overlapping infrared windows of all the Eastman Spectro Solvents. (From 2 to 16μ not a sliver has evaded overlapping.)

"I have a photo here"

You will find within the next couple of years that the mental image created by the word "photograph" will have altered. To think of a photograph as a piece of paper bearing a representation in tones of black, white, and grey will be like calling a man who flies an airplane an aviator or picturing a professor as bearded—perfectly proper but no longer general. The photographs that you file as records of work and observations and the photographs you pull out of your billfold at postprandial bull sessions will, in general, be in full color.

Here is what has been happening:

1) This year a new *Kodacolor Film* came out. It is as sensitive as the popular variety of black-and-white snapshooting film used to be not so long ago. It works equally well for daylight and clear flash without filters. It gives negatives from which can be made color prints and enlargements that you look *at*, not through.

2) There is now a *Kodak Color Print Material, Type C*. Prints made on it from Kodacolor negatives have the same color quality as used to be obtained only through vastly more involved techniques.

3) Processing chemicals for both the film and the print material are available in kits from all Kodak dealers. Quality of results tends to run commensurate with the degrees of care, zeal, and skill generated by the worker's needs or the hobbyist's self-fulfillment urge.

4) The fellow who, during the Great Depression, had some "Films Developed, Printed, and Enlarged" signs printed and placed in drug stores around town no longer operates from his kitchen. For the convenience of those who would just as soon not do it themselves, he has gone into color. To compete on both quality and price he finds it wise to own *Kodak Color Densitometers* and the like. His plant manager comes to Rochester for brush-up courses. He has met and mastered a complex technology, and he is determined to convince you that its product has it all over the monochromatic view of things.

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Fact and Artifact in the Biology of Schizophrenia

M. K. Horwitt

It appears important at this time to emphasize that many reports showing differences between patients with schizophrenia and normal individuals are based on environmental artifacts that are not related to the basic disorder. The practice followed by biochemical workers of requesting samples of blood or urine from subjects on psychiatric wards, with little more identification of the sample than that the patients have a mental disease, has many disadvantages.

We are now entering a period of renewed interest in biological research on schizophrenia. Nothing can be more harmful to this rejuvenation of the investigation of the biology of mental health than the publication of reports based on techniques of patient selection which do not meet the minimum standards accepted by other disciplines. Much of this conflict is due to a lack of understanding by some workers that the term *schizophrenia* is a general classification with many subdivisions, which are often only slightly related, and that the manner in which the patient chooses to manifest his difficulties may not be a function of his physiological status.

Symptoms that are usually considered artifacts in other studies are often erroneously accepted as biological aberrations in the evaluation of the schizophrenic patient. Year after year, papers appear which purport to distinguish between the state of schizophrenia and that of normalcy. The sum total of the differences reported would make the schizophrenic patient a sorry physical specimen indeed: his liver, brain, kidney, and circulatory functions are impaired; he is deficient in practically every vitamin; his hormones are out of balance, and his enzymes are askew. Fortunately, many of these claims of metabolic abnormality are forgotten in time with a minimum of polemic, but it seems that each new generation of biologists has to be indoctrinated—or disillusioned—without benefit of the experience of its predecessors. One is not certain where to place the blame for this weakness, but both editors and grant advisers could do well to insist on experimental design and interpretations of data which take into account some of the following, almost too obvious, variables.

The author is associate professor of biological chemistry at the University of Illinois College of Medicine, Chicago, and director of the biochemical research laboratory at Elgin State Hospital, Elgin, Ill.

Variables

1) *Emotional stress, tension, and anxiety.* One does not obtain basal metabolic results during fever or exercise, nor should one expect to obtain basal samples during emotional stress. One of the basic characteristics of the schizophrenic patient is his peculiar emotional reaction to his environment. These reactions will vary in kind and intensity with the individual and with time. A supposedly basal sample taken from a physically quiet but emotionally disturbed catatonic subject may not be basal at all but may be a reflection of metabolism during intense adrenergic stimulation. Adrenergic stimulation has a marked effect on the levels of amino acids in the biological fluids.

To compare the results from such a blood sample with those from blood of normal subjects is like comparing data from blood samples obtained during grief or stress of battle with data from blood obtained during relaxed, basal conditions. With experience and knowledge of the individual patient, one may learn to distinguish between the presence or absence of some emotional stresses. But, even under optimal conditions, a preliminary period of at least 3 to 6 months may be required to evaluate the stability of subjects chosen for a metabolic study (*1*) in order to eliminate those that are unpredictable. Even when this precaution is taken, some subjects may occasionally leave a previous metabolic pattern because of a temporary emotional stress situation.

In such a situation, if one requires data from unstressed subjects, the tests are repeated at a later date. If basal data cannot be obtained from a subject, the results should not be averaged with those from subjects who are not disturbed. To show that there are differences between the reactions of a normal subject and those of a patient in the early, active stages of mental disorder may give good leads on the effects of emotional trauma on the biochemistry of a subject, but great care should be exercised in interpreting data obtained from such patients as being biological aberrations characteristic of the basic disease. Recent confirmation by McGeer *et al.* (*2*) of the observations by Young *et al.* (*3*) of the increased excretion of aromatic compounds in the urine of "schizophrenics" would have been more useful if their studies had included estimations of tension and anxiety (and possible nutritional imbalance) of the subjects studied.

2) *Nutritional state.* Emotional stress affects the appetite of all of us in different fashions. Even in the best managed hospitals, unless food intake is strictly controlled, the vagaries of psychotic behavior are such that they affect optimum nutrient consumption in some patients who tend to go in and out of negative nitrogen balance with varying interactions of their delusional states. Relatively unimportant food idiosyncracies may, in time, become manifest as mild nutritional disorders. The metabolic changes which take place with even mild and often unrecognized nutritional disorders are more severe than the biological variations being sought in mental disease.

Having studied such changes in mental patients for more than 15 years, I am at a loss to understand how some studies

of urinary excretion or of blood constituents can be performed without recourse to nutritional controls. My experience is that it may take 3 months (or the equivalent of 3 days of a rat's life) to achieve a nutritional steady state after a change in the dietary regimen.

3) *Liver dysfunction or suboptimal liver function.* It has been frequently claimed that some schizophrenic patients have decreased rates of clearance of bromsulfalein or hippuric acid. The study of liver function in such patients is well worth more attention, but only additional work can clarify whether such changes are related to diet, inactivity, training, slower circulation time, physiological hibernation, infection, or other factors. Although the pattern of urinary excretion is not expected to vary in a 24-hour sample from subjects with mild liver dysfunction, tolerance tests that can evaluate the *rate* at which a substance is absorbed or removed, or both, from the blood stream may show sluggish activity in some schizophrenic patients.

In one controlled study, which was designed to estimate the effects of a diet that provided borderline levels of protein, signs of liver dysfunction became apparent and were not repaired until after the protein intake was raised (*4*). Whether a schizophrenic patient is more susceptible to liver disorder during protein deficiency or whether the slower removal of injected compounds is a consequence of long-term inactivity cannot be determined with the data at hand, but whatever the cause of mild liver dysfunction in the mental patient, the possible presence of such defects should be evaluated more frequently.

4) *Training.* One does not have to be oriented in athletics to recognize that the cardiovascular efficiency of an individual can be markedly influenced by repetitive exercise or work, or conversely, by extreme inactivity. The activity of mental patients may vary widely, from prolonged states of fierce agitation that are acted out by considerable physical movement, to conditions of relative hibernation. Such differences make for important variations in studies of oxygen consumption, circulatory rates, and all related concomitants of biological efficiency. When one considers that the maximum oxygen uptake of a trained individual may be double that of the untrained subject (*5*, *6*), it is not surprising to note that data from most biological studies on mental patients have greater variations from the mean than are obtained from nonpsychotic subjects. In addition, in most mental institutions there are patients who do productive work and others who remain sedentary for years, and the differences in functional muscle mass between these subjects are considerable.

5) *Diurnal variations.* Those acquainted with mental hospitals are aware of the great differences in night restlessness that may exist in various wards. Many mental patients have a high level of nocturnal activity. (It is assumed that sedated or tranquilized patients are not used for basal studies.) The all-too-frequent practice of comparing overnight urine samples from mental patients with similar samples from normal individuals can lead to unwarranted conclusions that might not be made if full 24-hour samples were collected instead. In this connection, one should also be aware of the prolonged fasting period of more than 14 hours between supper and breakfast that is a characteristic of many of our institutions and of the possible effect of such a schedule on diurnal variations.

Conclusion

It is earnestly hoped that investigators who are impelled to study the biology of schizophrenia or of other mental disorders will attempt to control the variables mentioned so that we may better distinguish between the causes of schizophrenia and its effects. Admittedly such controls are expensive and difficult to administer, but they are worthy of incorporation into any research program where man is the experimental subject. Much has been said about the faults of psychiatrists who do not make sufficient use of the laboratory concepts of cause and effect in evaluating mental disease. Conversely, the biologist should not be so naive in the interpretation of his data that he loses cognizance of the fact that schizophrenia is not a simple entity, and that he, too, must beware of the trap of confusing cause and effect.

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Physical Mechanism of Bacteriophage Injection

Aadne Ore and Ernest Pollard

It is currently accepted by many that a bacteriophage attaches itself to its host at the tip of its tail (*1*). It has also been found that the outer part of the phage particle, the protein coat, is left outside, while the inner part, which is predominantly desoxyribose nucleic acid (DNA), enters the bacterium and there undergoes multiplication (*2*). Very little is known about the mechanism of the penetration process. It is the purpose of this article (*3*) to show that quite ordinary physical processes offer the possibility of explaining the phenomenon of entry, and that, although no one clear explanation is presented here, there is certainly no reason to feel that this process offers anything extraordinary.

The processes we call attention to are, first, the linear Brownian movement of a long thin object through a tube containing a viscous medium and, second, the centrifugal pull exerted by oscillatory thermal movement of the part of the genetic thread that has already entered. The analysis we give of the two processes indicates that they can offer a plausible explanation for the entry of the viral DNA into the host, but that, under some circumstances, entry by these methods may be severely restricted. It is also suggested that hydration changes in the viral DNA might play a certain role.

The dimensions of the nucleic acid thread that enters the host are not accurately known. If we take the figures for phosphorus atoms per virus particle as given by, for example, Stent and Fuerst

Dr. Ore is a John Hartford research fellow at Yale University on leave from the University of Oslo, Norway. Dr. Pollard is a member of the Biophysics Department of Yale University, New Haven, Conn.

Table 1. Dimensions of virus tails.

Virus	l, assuming a single Watson-Crick structure B (in A)	l, from radiation data (in A)	Assumed r	Virus tail	
				length L	radius R
T1	2.4×10^5	1.1×10^4	10	1500	50
T2	7.7×10^5	1.25×10^5	10	1000	125
T5	6.0×10^5	Not available	10	1700	50

(*4*) and assume a single long unit of Watson-Crick structure B (*5*) we find DNA-lengths (l) for three bacterial viruses as given in the second column of Table 1. It would appear that these values of the lengths are overestimates, owing to the fact that plating efficiency enters into the calculations. Radiation data (*6*) for T1 and T2 indicate, for the same radius (r) of 10 A, smaller values for the lengths than would be calculated from the figures of Stent and Fuerst. The same is true of some unpublished work by one of us (E. P.) and Jane Setlow on T2. It is likely that these lower figures are due to the DNA's being coiled in some way, thus giving a low figure for the sensitive area. Whether such a coiled object is completely uncoiled as it enters the bacterium or whether a set of two or more molecules make up the physical unit is not, at present, known.

The dimensions given in Table 1 for the virus tails are those of frozen-dried phages as determined with the electron microscope by Williams and Fraser (*7*).

The processes we envisage are as follows. Subsequent to irreversible attachment (*8*) and production of the necessary opening in the bacterial wall and possibly also of liquefaction of some material in the phage, the "genetic thread" is expected to perform kinetic fluctuations in a viscous fluid. The resulting Brownian motion will be confined to a volume consisting of the interior of the phage-host complex. It is conceivable that the initially coiled structure will have to orient itself for one end of the thread to get into the tail. Estimates for the time taken, on the average, for fluctuations to lead to the desired result can be made in terms of rotational Brownian movement, and they indicate that such a process may be quite rapid compared with the actual passage through the tail, which is discussed in following paragraphs. It is presumed that the coil is not prevented by chemical forces from rotating and uncoiling.

As a first consideration we can suppose that the tube formed by the tail of the bacteriophage represents the "bottleneck." In our model then, the motion leading to entry into the bacterium will be approximated by a linear Brownian motion, with a mobility (*9*) corresponding to the conditions assumed to prevail in the tail. In computing this mobility, no attempt is made to take into account a possible non-Newtonian character of the fluid in question. Its viscosity coefficient is designated by η. The inner wall of the tube and the structure moving through it are considered as coaxial cylinders of radii R and r, respectively. Their respective lengths we denote by L and l.

As in the Einstein theory of ordinary Brownian motion, we need the mobility (velocity/resistance), which refers to uniform motion. In our case, the resistance per unit area equals η times the velocity gradient in the liquid, at the surface of the inner cylinder. The latter quantity is derivable from the hydrodynamic equations (*10*) for stationary viscous flow parallel to the axis. If we assume that the mass transport represented by the moving thread is always compensated by a net flow of liquid in the opposite direction, the resulting mobility B can be expressed as

$$B = \{2\pi\eta L f(x)\}^{-1}$$

where $x = R/r$ and

$$f(x) = \frac{x^2 - 1}{(x^2 + 1)\ln x - (x^2 - 1)}$$

For values of $l \gg L$, it suffices for our purpose to let the total length of the tube enter the expression for B. The type of flow just postulated is, however, by no means the only conceivable one. More favorable to rapid entry would be one that would give transport of fluid into the bacterium. According to the findings of Puck and Lee (*11*) of an increase in cellular permeability subsequent to the irreversible attachment of phages to their host cell, a flow of the latter type would not seem unreasonable. Rather than derive an alternative form of $f(x)$, we take it to be the following simple one,

$$f'(x) = \frac{1}{x - 1}$$

which would result if the fluid velocity could be approximated by a linearly decreasing function of the distance from the inner cylinder.

On our model, the time, t, required on the average for the genetic structure to enter the bacterium is approximately that taken for the root-mean-square displacement to equal the length l of the structure. Accordingly, we put (*9*)

$$t = \frac{l^2}{2kTB}$$

where k is Boltzmann's constant and T is the absolute temperature.

It will be seen that t is proportional to η. The value of the latter is unknown, but a value of 0.1 poise—that is, a value 10 times that of water at room temperature—is assumed. We take for the effective inner radius of the tail in the transient state the external values (Table 1) as determined (with some 10-percent accuracy) in the frozen-dried state. Alternative lengths and radii are considered for the entering substance. The values of these radii are such as to allow space for sufficient fluid to render the hydrodynamic approach not unreasonable. The results are summarized in Table 2. Both forms of the function $f(x)$ have been considered. T was placed equal to 310°K (37°C).

It will be seen from Table 2 that, on the basis of radiation data, our model leads to reasonable durations of the penetration process for T1 and T2. [Similar results were presented in a preliminary report (*12*).] Time values derived on the basis of determinations of total DNA content, however, are definitely too great when a radius of 10 A is assumed, although the results are more satisfactory for larger values of the radius, which would correspond to a folded Watson-

Table 2. Injection times taken for $\eta = 0.1$ poise and $T = 310°K$.

Virus	l (in cm)	r (in cm)	$x = R/r$	$f(x)$	t (in sec)	$f'(x)$	t' (in sec)
T1	2.4×10^{-5}	10^{-7}	5	1.35	860	0.25	160
	0.6×10^{-5}	2×10^{-7}	2.5	3.76	150	0.67	27
	1.1×10^{-4}	10^{-7}	5	1.35	2	0.25	0.3
	0.27×10^{-4}	2×10^{-7}	2.5	3.76	0.3	0.67	0.06
T2	7.7×10^{-5}	10^{-7}	12.5	0.642	2800	0.087	380
	0.31×10^{-5}	5×10^{-7}	2.5	3.76	26	0.67	5
	1.25×10^{-5}	10^{-7}	12.5	0.642	74	0.087	10
	0.06×10^{-5}	5×10^{-7}	2.5	3.76	0.7	0.67	0.1
T5	6×10^{-5}	5×10^{-7}	5	1.35	6100	0.25	1100
	1.5×10^{-5}	2×10^{-7}	2.5	3.76	1050	0.67	190
	10^{-5}	10^{-7}	5	1.35	170	0.25	31
	0.25×10^{-5}	2×10^{-7}	2.5	3.76	29	0.67	5

Crick structure, in particular, if the net flow of liquid is inward. It is interesting to note the value obtained for T5 in this case; it is of the order of a few minutes. Luria and Steiner (*13*) found the injection time for T5 to be several minutes. They suggested that the narrowness of the tail might be responsible for the rather slow penetration of the phage DNA. In our model, the length of this structure would appear to be equally important.

In proceeding, we wish to mention that one should perhaps not exclude the possibility of a stretching of the DNA subsequent to irreversible attachment and possibly enzymic liquefaction of part of the interior of the phage. It is well known that the length of Watson-Crick structure B, which represents purified DNA at high relative humidity, exceeds by 30 percent that of structure A obtained at a lower humidity (*5*). If a similar stretching does take place, it may cause part of the structure to be pushed into and partly through the tail. This would mean that our mechanism would need to be active for a shorter period of time, thus reducing the values presented in Table 2.

It remains to be considered whether partial entry into the bacterium changes the conditions radically enough for the foregoing model to become meaningless. In point of fact, it is conceivable that the process will be speeded after partial entry. Qualitatively, we may say that uncoiling and entry amount to an increase in entropy. Again, if biochemical reactions involving a reduction in free energy are initiated already by partial entry, the effect will amount to a pulling force. Similarly, the greater freedom of sidewise motion of the part of the thread pointing into the bacterium permits oscillations that give rise to a net centrifugal force. To get an idea of the size of this effect we can consider that a fraction λ of the thread is capable of such oscillation in a plane. Giving it a mean oscillatory kinetic energy of $\frac{1}{2}\ kT$ (thermal energy) we shall take this to be the instantaneous energy $E = \frac{1}{2}I\omega^2$, where I is the moment of inertia about the point of entry and ω is the angular velocity. In terms of mass (μ) and length, we have $I = 1/3\mu\lambda^2$, while the centrifugal force is $F = \frac{1}{2}\mu\lambda\omega^2$. Thus,

$$F = \frac{3E}{\lambda} = \frac{3KT}{2\lambda}$$

We conclude that, to the extent that these considerations apply, the force may accelerate the entry appreciably. Thus, if we insert in this formula a value for λ of, say, 100 A, the corresponding value of F is of the order of 10^{-7} dyne. The corresponding velocity (v) would be B times this quantity—that is, of the order of 10^{-2} cm/sec. If, more generally, the expression for F were valid during entry, the time taken for it to effectuate the process would be given by

$$t = \int dt = \int \frac{d\lambda}{v} = \int \frac{d\lambda}{FB} = \frac{l^2}{3kTB}$$

(assuming a constant B, compare preceding discussion). Hence, such an approach to the problem of entry would lead, essentially by itself, to durations of the process that would roughly equal those found by the preceding treatment based on the assumption of Brownian motion. To some extent, a centrifugal pull will occur which will stimulate entry; it would appear to be somewhat unrealistic, however, to neglect completely any freedom of transverse motion in the tail and also to employ the afore-stated expression for F throughout a large range of values of λ.

Although we definitely do not wish to claim that we have presented *the* mechanism for the entry of nucleic acid through the tail of a virus into the host bacterium, we do feel that the main mechanism proposed, which should take place in any case, together with the supplementary ones, offers a good possibility of explaining the method of entry. It should be noted that, since B depends on $1/\eta$ and t on $1/BT$, the time of entry should be temperature-dependent according to the factor, viscosity/temperature. If a method of measurement of the time of injection should become more practicable, this relationship could perhaps be verified to some extent. Likewise, observations with partial replacement of cellular water by a more viscous solvent (*14*) deserve consideration.

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Science and Freedom

Freeman Dyson

I spent 2 weeks in May of this year going to scientific meetings in Moscow, talking with Russian physicists and sitting in Russian laboratories. A dozen Americans and many other foreigners were there. All of us reported, after we came home, that we were astonished at the enthusiasm, the competence, and the solid achievements of the Russian scientists.

Now, the editor of the *Sun* asks me a question. He says, "It is commonly stated by men of science that freedom is essential to a healthy scientific climate. And yet we learn from members of your group that Russian science, which has surely had to put up with security arrangements more stringent than ours, is in a flourishing condition, and that Russian scientists show evidence of the highest morale in their personal and scientific life. How can this be so?" He invites me to set down my thoughts about this question. And I am happy to do so, because

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the question is a real and important one. If science is to continue to flourish in our country, we scientists must succeed in making our needs understood by the public. For this reason, I welcome every chance to explain our situation, and especially to explain the nature of the challenge being offered to us by Russia.

Not Yet as Good

First of all, let it be clearly said that Russian physics is not yet as good as American physics. We were amazed at their work, not because it is so wonderful in itself, but because it has improved so much so fast. We felt like Dr. Johnson, when he heard a woman preach and delivered his famous judgment: "A woman's preaching is like a dog's walking on his hinder legs. It is not done well; but you are surprised to find it done at all." Some of our group had worked in Russian laboratories before the war. In those days almost every piece of equipment more complicated than a screwdriver was imported, mostly from Germany. Those gadgets which were made in Russia were not expected to function.

Today, all that has changed completely. The Russians know how to make scientific equipment, equal in quantity and quality to any in the world, and they have plenty of people who know how to use it. It is the speed and suddenness of their progress which are impressive. What they have done with their equipment is not yet so exciting. Since the war, six first-class and revolutionary experiments have been done in physics. Of these, one was done in Italy, one in England, and four in the United States. None so far in Russia.

The second main fact which we established beyond doubt was this. Russian work in physics is now essentially free. I am not speaking here about political freedom. This, of course, does not exist in Russia, and will not exist in the foreseeable future. But a reasonable scientific freedom does now exist. That is to say, Russian physicists enjoy the basic professional freedoms, to work on problems of their own choosing, to publish their results, and to discuss their ideas with foreign colleagues. These freedoms are restricted by security rules which are similar to ours, perhaps slightly stricter. In my own conversations, I found the only subject the Russians were unwilling to talk about was the construction of their latest electronic computers. This subject was clearly "classified" for them, although it is "unclassified" for us. On the other hand, they could talk about some experiments relating to thermonuclear reactions, which for us are still classified.

Freedom Is New

The freedom of Russian science is quite new. It came suddenly, soon after the death of Stalin. Until 2 years ago, nothing whatever was published of experimental work in nuclear physics. There was no possibility of personal contacts with foreign scientists, even from the satellite countries. And a high proportion of the physicists were engaged in military work. Two years ago, the whole atmosphere changed. People poured back from the military projects into pure science, publication was encouraged, and international meetings allowed.

All this had an intoxicating effect on Russian scientists. Suddenly to be given these freedoms, which they had not known for 15 years, filled them with optimism and self-confidence for the future. All the time we were in Russia, we could feel how happy they were to be allowed to talk to us. Their enthusiasm and high morale are directly caused by their new experience of freedom. The superstrict security system of Stalin's time produced high morale only in this negative way, like the man in the lunatic asylum who continually beat his head against a brick wall because it felt so good when he stopped.

The good experimental work which has been done in Russia was done after the new regime began. We found clear evidence that the different laboratories in Moscow had been isolated from each other during the earlier time, and that this had hampered their work considerably. For example, the big cyclotron in Moscow had been working since 1949, and was for several years a better machine than any working in this country. But nobody with imaginative ideas for new experiments had access to it, and so the basic experiments which established the properties of the meson were all done in America.

It is clear that the Soviet Government now understands the fact, which the American Government always knew, that scientific progress demands scientific freedom. It is also clear that the Soviet Government is spending enormous amounts of money on pure science, and seriously intends to make Moscow the scientific capital of the world. They have understood that the power of American science depends on America freely and openly attracting people and ideas from all over the world. And they intend now to beat us at our own game.

Public Support

I will end this discussion with one little story. After the meetings were over, a group of foreign scientists with two interpreters went sightseeing in the country around Leningrad. We walked by mistake into some kind of coast-guard station, evidently a restricted area, but nothing of importance. An ordinary Russian seaman came out to shoo us away, shouting, "*Nelzya*," which means "forbidden." At the same time, we noticed that our interpreters, evidently unwilling to be held responsible for this error, were walking rapidly away in the opposite direction.

So we stayed and had a friendly chat with the seaman in our broken Russian. When I said we were foreign scientists, he immediately said, "Oh, I know who you are. You are the people who have been at the meeting in Moscow, and you know all about pi-mesons and mu-mesons." He pulled out of his pocket a crumpled copy of *Pravda* in which there was a report of our proceedings. He talked then with great warmth, saying, "Why do you not come to our country more often?" and, "Be sure to tell the people in your countries, and your wives and children, that we would like to see more of them."

I am fairly sure that this sailor had not been planted, briefed, or warned beforehand of our coming. If it had been a plant, the interpreters would not have walked away. And in Moscow I talked with several other nonscientific Russians whom I met casually in the street, and they all made the same kind of response to me.

The moral of this story is that the ordinary Russian people have an understanding of the value and importance of pure science. And they understand and take pride in the fact that learned foreigners come to their country to exchange ideas. It is the atmosphere of public understanding which makes the prospects for the future of science in Russia look so bright. Their scientists have a professional freedom which is not much less than ours, and they have a public support which is in some ways much greater. I can only hope that an American coast-guard sentry, confronted unexpectedly with a group of Russian physicists speaking broken English, would have behaved with equal intelligence and respect.

First get your facts; and then you can distort them at your leisure—MARK TWAIN.

L. Reiner, Chemist and Medical Scientist

The recent death of Laszlo Reiner brought to an end an impressive career devoted to chemical and medical research. Some idea of Dr. Reiner's scientific contributions may be gathered from his 110 publications and the diversity of his interests from the many professional societies of which he was a member. Impressive as were his scientific achievements, however, of even greater importance were his personal accomplishments. His life was a constant devotion to learning. A European education gave him a much broader cultural background than one usually acquires in this country. He spoke and read several languages, and his knowledge of literature, philosophy, and the arts in general approached that of the expert. He loved music, favoring Bach and Mozart, and was an accomplished pianist. It was always a great pleasure to his friends when he would sit down to the piano and play his favorite pieces. Nor was the physical side neglected, for Dr. Reiner was a powerful swimmer and enjoyed tennis and other outdoor activities until the last year of his life.

Dr. Reiner was extremely idealistic, almost to a fault, and set for himself and others only the highest standards of intellectual integrity. A kindly, soft-spoken man, he generated enthusiasm that was a constant source of inspiration to all with whom he came in contact. Those of us who knew Dr. Reiner are mourning the loss of an inspiring teacher, a wise counselor, and a wonderful friend.

Laszlo Reiner was born in Budapest, Hungary, in 1894, where he resided until he received his M.D. degree from the University of Budapest in 1917. He saw service with the Royal Hungarian Army, first as a sanitary officer and for the last 2 years as a lieutenant-surgeon, and was cited for bravery and twice decorated. Early in his medical studies Dr. Reiner realized that he would derive the greatest satisfaction from medical research, rather than from practice, and endeavored to obtain all the training that he could to qualify him for this field of medicine. Following the cessation of hostilities, he therefore continued his studies at Frankfort, Germany, and was granted a Ph.D. degree in physical chemistry in 1921.

For a number of years Dr. Reiner taught hygiene and public health at the Royal Elizabeth University in Hungary, attaining the rank of associate professor; it was during this period that the love for teaching, which remained with him to the end of his days, was nurtured and developed. In 1924 the Rockefeller Foundation granted him a traveling fellowship, part of which was spent in the laboratories of L. J. Henderson and of E. J. Cohn at the Harvard Medical School and the major part at the Rockefeller Institute for Medical Research with K. Landsteiner.

Dr. Reiner's major fields of interest were immunology, chemotherapy, and protein chemistry; very early in his research career he began to demonstrate the ability to combine his knowledge of chemistry and medicine in order to make significant contributions to their fundamental aspects. He did pioneering work in the field of serum proteins, particularly serum globulins, reporting the first measurement of their migration velocities in an electric field at various hydrogen-ion concentrations in 1927. Before Tiselius developed methods for the fractionation of serum proteins, Dr. Reiner showed that antibodies against infection are proteins, specifically globulins. He isolated serum globulins having different isoelectric points and demonstrated that antibodies are associated with those globulins whose isoelectric points are at nearly neutral pH values. These globulins were later identified by Tiselius and named gamma globulins.

From his researches in protein chemistry resulted the development of globin insulin in 1939, the first insulin of intermediate action, which achieved results not then obtainable from any mixtures of unmodified insulin with the slower-acting protamine insulin. One of the physiologically active insulin derivatives containing radioactive iodine which he prepared was used in studies of the distribution of insulin in the body and of the rate of resorption from the site of injection (1941–44). This work was among the earliest uses of tracers in medical research.

It was at the outset of this work in 1941 that I first met Dr. Reiner. He had come to America to stay permanently in 1929 because of the rapidly worsening political situation in Europe, and he became a naturalized citizen as soon as possible thereafter. He taught bacteriology at New York University and, at the same time, became associated with the research laboratories of the Burroughs Wellcome Company at Tuckahoe, New York, first as consultant, then head of the department of medicinal chemistry, and finally as scientific director. His understanding, guidance and friendship in this, my first research position, and through later years, has been the most important single influence in my own professional career.

From 1942 to 1953 Dr. Reiner was director of pharmaceutical research for the Wallace and Tiernan Company of Belleville, New Jersey. He earned the gratitude of countless servicemen in World War II by his development of Desenex, a fatty acid-containing fungicide, the most effective preparation then known for combating the spread of dreaded "jungle rot."

Some years ago there was a report of convulsions produced in dogs fed bread made from flour that had been treated with certain commonly used bleaching agents. Dr. Reiner isolated and identified the highly specific neurotoxic agent as methionine sulfoximine and synthesized it and other members of this hitherto unknown class of compounds.

In 1954 Dr. Reiner accepted a position as research associate at the Institute of Cancer Research at the College of Physicians and Surgeons of Columbia University, where his final scientific studies explored the physicochemical reasons for the selective concentration of certain drugs in cells. Only a week before his death on 27 November 1955, knowing that his days were numbered, he was still dictating letters and planning the future course of his research program, communicating to those around him not despair but rather his zest for living and enthusiasm for learning.

MILTON GREEN

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I did not think; *I investigated.*—W. K. ROENTGEN.

News of Science

Urine of Anthropoid Apes

The comparative biochemistry and physiology of the order Primates represent almost unexplored fields. The few existing studies, however, indicate their value in assessing phylogenetic relationships. Hence any contribution in this area is of considerable interest. Gartler, Firschein, and Dobzhansky [*Am. J. Phys. Anthrop.* **14**, 41 (March 1956)] have recently studied the urinary amino acids of anthropoid apes (37 chimpanzees, six gorillas, three orang-utans, two gibbons) using techniques of paper chromatography.

Several striking differences between man and apes are apparent. Experiments indicate that diet is not an important factor in their production. Man excretes much more creatinine and histidine, whereas the apes excrete much more glutamic and aspartic acids. Urinary beta-alanine seems to be absent in orang and gibbon and is rare in man, but it is quite common in both chimpanzee and gorilla. The authors note that although fundamental differences in intermediary metabolic mechanisms are suggested, definitive evaluation requires thorough investigation of metabolism, particularly of renal clearances, in the apes.

In their high glutamic and aspartic acid concentrations and low creatinine content, anthropoid ape urines resemble those of human infants, rather than those of adult men. On the other hand, the histidine content is not particularly low in infant urine, nor is beta-alanine frequent.

Differences between the several ape genera appear less pronounced than those between apes and man. Histidine excretion rates are probably higher in chimpanzees than in other anthropoids, and gorillas seem to possess uniquely high excretion rates of aspartic and glutamic acids, glycine and alanine. But more observations are needed.

Various excretion rates differ not only between ape genera but also between individuals of a genus, coefficients of variation often being of the order of 100. Chimpanzees vary most, at least as much as men.

Since complete daily urine samples are difficult if not impossible to secure in nonhuman primates, the water content of samples varied greatly. Concentrations of most substances were therefore expressed in terms of milligrams per milligram of creatinine excreted. Creatinine was chosen as a standard because it is excreted in man at daily rates that vary less than those of other substances, being strongly correlated with total muscle mass. The authors note, however, that use of this standard presents a problem when comparing amino-acid excretion rates. For creatinine concentration is much the highest in man, being three times that of the chimpanzee and seven times that of the gorilla. Consequently, an apparent difference in amino-acid rates may merely reflect a difference in creatinine concentration. This must always be kept in mind when comparisons are made.

The meaning of this striking dissimilarity in creatinine concentration between man and anthropoids is not clear. It appears most likely to the authors that a difference in volume of urine passed per unit of body weight in a given time is a major factor. They conclude that if creatinine excretion is a measure of muscle mass, a gorilla must excrete at least as much as, and probably more than, a man. Consequently, considering the average creatinine content, a gorilla must produce about seven times as much urine per diem as a man. But, since adult gorillas may attain a body weight of some 600 pounds, this figure seems far too low; rather, on this basis, one would expect the daily urine output of an adult gorilla to be at least 15 or 20 times that of an adult man. Because this appears more than unlikely, some other factor must be involved. Perhaps the answer lies in unlike renal-clearance mechanisms.

This study is a valuable contribution to primatology. But it is obvious that the real significance of a study of this sort can hope to become apparent only after it has been broadly extended to include other primates as well.—W.L.S., Jr.

Trailmarkers for Arctic

An electronic technique for marking trails in the arctic has been developed by the Army's Engineer Research and Development Laboratories, Fort Belvoir, Va. A system consisting of two parallel wires and a vehicular-mounted radio-type receiver has been successfully tested on the Greenland Ice Cap.

An alternating current is fed into the wires, which are buried beneath the snow on either side of the trail to mark the route electrically. The receiver, on a tracked vehicle commonly known as a "weasel," detects the current in the wires. Indicators in the vehicle give the driver his position within the trail. Warning devices alarm the driver when the vehicle gets out of bounds and crosses a trail wire.

Poor visibility during the polar night, snow storms, and dense arctic fog make free movement over the ice cap virtually impossible. Travelers face the possibility of getting lost and falling into hidden crevasses. Bridged over slightly with snow, crevasses are dangerous even in good visibility. An electronic trail is now being extended over 100 miles on the ice cap.

Work is continuing at the Fort Belvoir Laboratories and at General Mills, Inc., Minneapolis, Minn., to improve existing techniques and equipment. A new design is already under test on the ice cap, and a simplified one-wire trail-marking system that may reduce installation and maintenance costs is also under consideration.

Tarnishing of Silver Mirrors

The behavior of front-silvered mirrors is of considerable interest to the laboratory physicist and chemist. The material presented here was contained in an article by H. Koenig and E. Kirste that appeared in the June issue of *Die Naturwissenschaften*.

It is commonly assumed that tarnishing is caused by silver sulfide. Some time ago it was found that the reflectivity of a silver mirror can be considerably increased if its silver surface is exposed to vapors of nitric acid or hydrogen peroxide immediately after evaporation in a high vacuum. X-ray diffraction shows only the rings corresponding to silver. Therefore, silver layers of about 30-angstrom thickness were deposited on collodion; immediately after they were prepared, they were exposed to nitric acid or hydrogen peroxide vapor and investigated by electron diffraction. The resulting diagram showed definitely the formation of silver chloride. This also was proved by chemical tests.

It is therefore necessary to assume that very small traces of chlorine in the chemicals or in the air of the laboratory produce the silver chloride on the surface of the silver mirror. Actually, it is possible in 1 or 2 weeks' exposure to the air to get the strongest silver chloride rings in electron diffraction, and only after more than

3 weeks is the diffraction diagram of silver sulfide found.

The rate of reaction of the transformation of silver into silver chloride in air can be considerably increased by exposure at between 200 and 250°C. In this case, in only half an hour, very thin layers of silver are changed to silver chloride. In this way extremely sensitive detection of the chlorine content of air is possible. Silver layers are of course transformed into silver chloride if they are exposed to hydrogen chloride vapor. However, if the layers are heated in chlorine-free oxygen for several hours at 250°C, no silver chloride is formed, and the diffraction pattern shows only the characteristic silver interferences.

The increase in the reflectivity of the silver mirrors after treatment in nitric acid or hydrogen peroxide vapor is therefore caused by a covering layer of silver chloride, and the high refractive index of the covering layer of suitable thickness produces the increase in reflectivity.—K.L.-H.

New Adenovirus Vaccine

The Public Health Service and the Department of the Navy have jointly announced preliminary results of a field trial of a new virus vaccine developed against certain respiratory diseases prevalent in military recruits. The results showed that the vaccine prevented from 50 to 70 percent of the total reported respiratory illnesses characterized by fever. These illnesses are of the grippe variety and do not include the nonfeverish infections generally designated as the common cold.

Approximately 4000 recruits at the Naval Training Center, Great Lakes, Ill., were given the vaccine, which was developed at the National Institute of Allergy and Infectious Diseases in Bethesda, Md. Results of the vaccine evaluation are reported in the 18 Aug. issue of the *Journal of the American Medical Association*. The authors are Joseph A. Bell, Matthew J. Hantover, Robert J. Huebner, and Clayton G. Loosli. Bell and Huebner are PHS investigators, Hantover is in charge of research at the Great Lakes Naval Training Center, and Loosli is head of the department of preventive medicine at the University of Chicago.

The vaccine was prepared from adenoviruses Types 3, 4, and 7, formerly designated as APC viruses. A substantial proportion of the feverish respiratory illnesses that occurred in both vaccinated and unvaccinated recruits was shown to be due to Type 4 adenovirus. Illnesses caused by Types 3 and 7 were not prevalent during the period of observation.

In summarizing their results, the authors state that "all evidence indicates that the vaccine induced a substantial reduction in the occurrence of acute febrile respiratory illness associated with adenovirus Type 4." Similar results have been obtained in vaccine studies by Army investigators working with the same group of respiratory viruses.

Child Care Council

Seventeen leaders in pediatric medicine have announced the formation of the National Council on Infant and Child Care, Inc., an independent nonprofit organization formed for the purpose of providing medical counsel in the utilization of mass media. Allan M. Butler, professor of pediatrics at the Harvard Medical School, and chief of the Children's Medical Service at Massachusetts General Hospital, Boston, is president of the council.

Plans for the NCICC include the establishment of an information service for reporters who write on medical subjects for newspapers, radio, television, and popular magazines. The NCICC will inaugurate awards for outstanding contributions to public understanding of matters pertaining to the health and welfare of infants and children. The council has also adopted a "Code for Advertising" to "encourage truthful, informative promotion of products that are important to child health." The code will be available to manufacturers of medical and nutritional products to assist them in conducting their promotion along lines that would provide factual information to the public.

The NCICC has established headquarters in the New York Academy of Sciences Building in New York City. Margaret Lyman, former pediatrics research fellow of the Public Health Service at the State University of Iowa, has been appointed educational director and will devote full time to this function. The council is supported by grants from interested business concerns and other organizations.

NSF Appropriation

The appropriation for the National Science Foundation for fiscal 1957 as finally approved is $40 million, compared with $16.12 million in 1956. The funds will be allocated in the following principal ways (comparable figures for 1956 are in parentheses): support of basic research in the sciences, $16.25 million ($9.3 million); development of manpower (fellowships, science education, register of scientists, including $9.5 million for summer institutes for high-school teachers), $14.5 million ($3.6 million); scientific facilities, including $3.5 million for the radioastronomy observatory in West Virginia [*Science* **124**, 310 (17 Aug. 1956)], $5.8 million ($800,000); communication of scientific information, including translations from the Russian and making available U.S. Government publications through support of programs in the Office of Technical Services and the Library of Congress, $900,000 ($550,000); policy studies, including statistical studies of research in the United States, $750,000 ($680,000); management and executive direction of the NSF, $1.8 million (1.19 million).

Mist Control Made Easy

Two USDA plant pathologists, C. May and E. Hacskaylo, have improved a device for controlling and maintaining moisture in greenhouse propagating rooms. Despite its relative simplicity, the new device has proved reliable and long-lasting. It is made up of a small porous clay globe, a few inches of small-diameter glass tubing, and a foot or so of copper or nichrome wire.

The clay globe is known to scientists as a Livingston atmometer. The assembly of the other parts is new. During misting, water collecting inside the globe fills the glass U-tube, which also contains one of the wires leading to the switch of the mist machine. When water reaches high enough in the tube to make contact with the other wire, the circuit is completed and the mist machine stopped. When evaporation from the globe drops the water to a level low enough to break the circuit, misting begins again. The device has helped grow a high percentage of strong, well-rooted cuttings, reducing the unit cost of controllers and speeding research.

Stratosphere Laboratory

Two naval observers have just completed a high-altitude meteorological experiment while on a "skyhook" plastic balloon flight. The research involved short-range photography of vapor trails produced by jet aircraft. One phase of the Office of Naval Research "stratolab" program is to conduct research from a manned "space" laboratory attached to a plastic balloon.

This initial manned flight reached an altitude of 40,000 feet. The program's objective is to provide a laboratory in the stratosphere for observers to conduct research that cannot be carried out by other means. The recent successful flight is the culmination of 10 years of "skyhook" research by ONR. The new laboratory will be used for sustained periods at varying altitudes, and future flights are expected to go significantly higher.

News Briefs

■ Argentina has completed an agreement with the World Health Organization under which it becomes the first country in the Western Hemisphere to have a center for the study and control of zoonoses (diseases transmitted from animal to animal or from animals to man). At present there are not less than 86 diseases of wild and domestic vertebrates that are known to threaten human health. The Argentine government has provided facilities for the center and has made an initial allocation of approximately $28,000 for its operation. WHO has contributed $45,000 to the first year's budget, and other organizations are expected to contribute in the future.

■ The Air Research and Development Command has announced plans to construct a plant at Rome, N.Y., to test parts for radar defense systems. The facility will be used by Air Force engineers and contractors working on developing radar components such as transmitters and tubes.

■ West Germany and India have agreed to set up jointly an Institute of Technology in India. The Bonn Government's share in the enterprise will be the procurement of equipment and teaching staff. The new institute probably will be set up in Kanpur (in Uttar Pradesh). It will be the third of its kind; the first two institutes are in Bombay and Kharagpur. A fourth is being planned for Madras.

■ The new building of the Max-Planck Institute for Chemistry in Mainz, West Germany, where the research center found a new home after the bombing of its buildings in Berlin-Dahlem, has now been dedicated. Many well-known chemists from Germany and abroad were present at the ceremony. In an address, the president of the Max-Planck Society, Nobel prize winner Otto Hahn, stressed the point that the work of the institute will be confined solely to peaceful purposes.

Scientists in the News

NEWMAN A. HALL, assistant dean in charge of the graduate division of the College of Engineering at New York University, has been appointed professor of mechanical engineering and chairman of the department at Yale University.

COLUMBUS O. ISELIN, professor of oceanography at Harvard University and chief oceanographer at Woods Hole Oceanographic Institution, has been named director of the institution. He succeeds EDWARD H. SMITH, who has been director since 1950. Smith had reached retirement age and did not wish to remain in office beyond his 6-year term of appointment.

CHARLES DODDS, Courtauld professor of biochemistry at the Middlesex Hospital Medical School, London, England, will deliver the 33rd course of Lane medical lectures at Stanford University between 17 and 21 Sept. The theme of the five talks will be "Biochemical experiments in endocrinology."

Three Stanford University professors are going abroad for extended visits.

LEONARD I. SCHIFF, executive head of the physics department, will spend a year on sabbatical leave at the Sorbonne. He has received a Guggenheim fellowship and will serve as visiting professor of theoretical physics on the faculty of science, Ecole Normale Supérieure, University of Paris.

SIEMON W. MULLER of the School of Mineral Sciences, another Guggenheim fellow, will spend 9 months at the University of Vienna conducting research in paleontology and participating in a geologic survey for the Austrian Government. In the final months of his sabbatical year he will carry out field work in Jurassic rocks on the island of Majorca. He also holds a Fulbright award.

GEORGE A. FEIGEN of the physiology department will spend his sabbatical year at Oxford University as the first traveling scholar appointed by the American Heart Association. He will continue his investigations in molecular biology in Oxford's departments of pharmacology and hematology.

Recent Deaths

RALPH N. CHIPMAN, Plainfield, N. J.; 70; specialist in weed control; 19 Aug.

KATHERINE CLENDINNING DURKEE, New York, N.Y.; 63; managing editor of *Mechanical Engineering* and other publications of the American Society of Mechanical Engineers; 16 Aug.

HERMAN FREUND, New York, N. Y.; 70; mechanical engineer; former vice president in charge of research and development for the Intertype Corporation; 18 Aug.

WIGHTMAN W. GARNER, Washington, D.C.; 80; plant physiologist who was a specialist in tobacco culture; 19 Mar.

W. LEON GODSHALL, Bethlehem, Pa.; professor of international relations and head of the department at Lehigh University; representative of Pi Gamma Mu on the AAAS council; 1 June.

EDWARD S. MEAD, Philadelphia, Pa.; 82; professor emeritus of finance at the Wharton School of Finance of the University of Pennsylvania; father of Margaret Mead, a member of the AAAS board of directors; 21 Aug.

HENRY A. SALLER, Columbus, O.; 38; specialist in nuclear metallurgy who had recently been named an assistant technical director at Battelle Institute; 14 Aug.

EDMOND L. SCHMIDT, Storrs, Conn.; 36; histologist and physiologist at the University of Connecticut; 7 Aug.

SARAH L. W. STARR, Philadelphia, Pa.; 82; president of the Woman's Medical College of Pennsylvania from 1921 to 1941; 17 Aug.

GEORGE W. STEWART, Iowa City, Iowa; 80; head of the physics department at the University of Iowa from 1909 to 1946; secretary of AAAS-Section B from 1917 to 1920; 16 Aug.

Education

■ The Atomic Energy Commission has announced that it has invited proposals from colleges and universities to conduct courses in nuclear reactor technology and supporting subjects as part of a program to double the number of nuclear reactor engineers trained each year at the Oak Ridge School of Reactor Technology (ORSORT) at Oak Ridge National Laboratory. The program provides that students accepted for the Oak Ridge school will take the first 6 months of their training at colleges or universities, beginning about 1 Mar. 1957, and the remaining 6 months at Oak Ridge. At the present time, the entire 1-year course is given at the laboratory.

Universities and colleges have been invited to submit proposals before 15 Sept. under which they would provide concentrated preparatory instruction in mathematics, physics, chemistry, and engineering. The subjects to be covered in the university phase of the proposed program will be unclassified. The ORSORT portion of the program will cover classified subjects. Inquiries regarding proposals should be directed to Dr. H. M. Roth, Director, Research and Development Division, U.S. Atomic Energy Commission, P.O. Box E, Oak Ridge, Tenn.

■ The 25th Norelco School on the use of x-ray diffraction will be held at the Sir Francis Drake Hotel in San Francisco, 24–28 Sept. The course is sponsored by the Instruments Division, North American Philips Company, Inc. Those interested in attending these x-ray diffraction meetings should register at once by writing C. J. Woods, Instrument Division, North American Philips Company, Inc., 750 South Fulton Ave., Mount Vernon, N.Y.

■ The controlled production of energy by thermonuclear fusion will be the subject of a new evening graduate course to be given in September by Stevens Institute of Technology. This is perhaps the first course ever offered in this field.

Grants, Fellowships, and Awards

■ The Public Health Service has awarded 3967 research grants totaling $48,879,678 from fiscal year 1957 funds appropriated to the National Institutes of Health, Bethesda, Md. The grants, which will aid research in medical schools, universities, hospitals, and other non-Federal institutions throughout the country, were distributed as shown here. The first amount given is for new grants and the second is for continuations; the figures in parentheses indicate the number of grants in each group. (i) Allergy and Infectious Diseases, $2,569,801 (237); $3,721,027 (340): (ii) Arthritis and Metabolic Diseases, $2,086,304 (224); $4,244,724 (375): (iii) Cancer, $2,195,517 (164); $7,673,339 (485): (iv) Dental Research, $382,217 (47); $519,277 (55): (v) Heart, $2,479,990 (240); $7,927,040 (596): (vi) Mental Health, $765,458 (76); $2,801,539 (158): (vii) Neurological Diseases and Blindness, $1,259,352 (120); $3,718,515 (328): (viii) NIH General (including nursing research), $2,614,335 (192); $3,921,243 (330).

■ A booklet describing the Social Science Research Council's fellowships, grants, and summer training institutes will be distributed about 1 Oct. Most applications will be due not later than 7 *Jan. 1957*. Inquiries should be addressed to the council at 726 Jackson Place, N.W., Washington 6, D.C.

■ In 1957 the National Academy of Sciences–National Research Council will conduct its second annual program of geographical field research in foreign areas. Financial support is provided by the Office of Naval Research. Under the initial program in 1956, ten young Americans are going abroad, for periods ranging up to 14 months, to conduct field research on topics of their own choosing.

The objective of the program is to strengthen American geography by stimulating greater participation by young Americans in field research in areas outside of the United States. Support will be made available not only to geographers but also to scientists in related fields, such as geomorphology, climatology, ecology, and pedology.

The program is designed primarily for graduate students who wish to conduct field research in connection with their doctoral dissertations, but those who have received their doctorates within the last few years are also eligible. More mature scholars may submit research proposals to the Geography Branch, Office of Naval Research, Washington 25, D.C.

The extent of financial assistance will vary according to the needs involved. The intent is to provide adequately for travel, field, and living expenses, without salary or stipend to the investigator. A preference will be shown for field investigations of at least 6 months' duration; programs of a year or more are desirable. Recipients of support must agree to submit a detailed report of their investigations, suitable for publication, to the Division of Earth Sciences, NAS–NRC.

Applications for support of field work to be initiated before 1 Apr. 1958 must be submitted *before 1 Dec. 1956*. All applications, inquiries, or requests for further information should be addressed to: Foreign Field Research Program, Division of Earth Sciences, 2101 Constitution Ave., Washington 25, D.C.

In the Laboratories

■ The new Westinghouse Research Laboratories in Churchill Borough, 10 miles from Pittsburgh, Pa., will be dedicated next month. Construction of the new laboratories was started in June 1953, but it was not until recently that the job of moving 50,000 pieces of laboratory equipment from the old laboratories in Forest Hills was completed. Full-scale research activities now are under way at the new location, where a staff of more than 700 is employed.

The dedication events will begin on 12 and 13 Sept. with a 2-day press preview for science writers and editors. On 20 Sept. a formal dedication ceremony will be held in the laboratories' auditorium before an audience of scientific, civic, and business leaders, and an open house for the general public will be held on 22 Sept.

■ The Battelle Memorial Institute, Columbus, Ohio, has been licensed by the Atomic Energy Commission to operate a research reactor at a site about 15 miles west of Columbus in Jefferson, Ohio. The reactor is a modified pool-type facility designed to operate at 1000 kilowatts, using contained uranium-235 as fuel.

■ Stanford Research Institute has announced the formation of a mathematics group. Activities of the group will include mathematical and statistical consultation, mathematical research projects, and a computation service for the institute. Short courses in analog and digital computation will be given for the staff.

Clay Perry has been named to head the new group, which will include George Evans, assistant head; Clarence M. Ablow, senior research mathematician; Carson Flammer, senior mathematical physicist; and Ralph E. Keirstead, research mathematician and chief programmer.

Miscellaneous

■ The International Commission on Zoological Nomenclature has announced that beginning 24th Feb. 1957 it will start voting on the following cases involving the possible use of its plenary powers for the purposes specified against each case. Full details were published on 24 Aug. in the *Bulletin of Zoological Nomenclature* (vol. 12. Pts. 6 and 7/8: (i) *alligator* Blumenbach, 1799 (*Lacerta*), suppression, to protect *mississipiensis* Daudin, [1801–1802] (*Crocodilus*) (Cl. Reptilia); (ii) *Campsicnemus* Haliday, 1851, validation (Cl. Insecta, Order Diptera); (iii) *Elaphella* Bezzi, 1913, and *Lophiotherium* Gervais, 1850, validation (Cl. Mammalia); (iv) *verrucosa* Sars, 1901 (*Alona*), validation (Cl. Crustacea, Order Cladocera); (v) *Candona* Baird, [1846], designation of type species for and *Herpetocypris* (emend. of *Erpetocypris*) Brady and Norman, 1899, validation (Cl. Crustacea, Order Ostracoda); (vi) *Conchoecia* (emend. of *Conchaecia*) Dana, 1849, validation of and designation of type species for (Cl. Crustacea, Order Ostracoda); (vii) *Anchisauripus* Lull, 1904, and *Otouphepus* and *magnificus* (*Otouphepus*), both of Cushman, 1904, supression (Cl. Reptilia Theropoda [Ichnites]). Comments should be sent as soon as possible to the secretary of the commission, Francis Hemming, 28 Park Village East, Regent's Park, London, N.W.1.

■ The Navy's High Temperature Project, 5 years of research into new methods for production and maintenance of extremely high temperatures in special furnaces, is summarized in a final report by J. B. Conway and A. V. Grosse that has just been made available through the Office of Technical Services. The project, initiated in 1949, covered two phases, combustion of metals and combustion of gases. The report summarizes specific investigations in each category and refers to detailed reports issued periodically during the work. *Office of Naval Research High Temperature Project, Final Report*, may be obtained for $1.75 from OTS, U.S. Department of Commerce, Washington 25, D.C.

Reports

Congenital Malformations Produced by Amniotic-Sac Puncture

It has recently been reported (*1–3*) that the sex of the human fetus can be diagnosed with a high degree of reliability by examination of cells from amniotic fluid at any time from 8 weeks (*2*) to term. For this and other reasons (*4*), there are likely to be further experiments in which attempts will be made to obtain samples of amniotic fluid from women as early as possible in pregnancy. The theoretical possibility of harm to the fetus from such procedures has already been pointed out (*3*), and the present paper reports experimental evidence to this effect.

During studies in this laboratory, where attempts were made to inject substances into the amniotic sacs of mouse embryos (*5*), it was found that amniotic-fluid leakage caused teratalogical abnormalities. This was confirmed in further experiments (*6*). The uteri of pregnant mice were exposed through a midline abdominal incision, on day 13 of gestation (the day a vaginal plug was observed being day 0). A No. 26 hypodermic needle was inserted through the uterine wall and amniotic sac into the amnion of each embryo in one uterine horn, but nothing was injected. The embryos in the other horn were counted and acted as controls. The mother was then sewn up and reopened for examination of the embryos on day 18, just before term.

Of 14 treated mothers, six aborted or resorbed their litters. In the remaining eight litters, ten out of the 17 treated embryos that survived had cleft palates, whereas the palates of the 15 control embryos were closed. This is a highly significant difference ($p = 0.0003$ by Fisher's exact method). These cleft palates appear to have resulted from a loss of amniotic fluid, which constricted the embryo, pushing the head down on the chest and forcing the lower jaw upward. Thus the tongue was forced between the palatine shelves, which therefore could not fuse.

Our results with mice suggest that there may be a definite risk to the baby in inserting a needle into the amniotic sac in human beings, especially during the early stages of pregnancy when there is the danger of inducing abnormalities in the developing embryo. (*7*).

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5. B. E. Walker and F. C. Fraser, in preparation.
6. D. G. Trasler, Ph.D. thesis, McGill University, in preparation.
7. Financial support from the National Research Council of Canada is gratefully acknowledged.

13 July 1956

Production of Increased Circulating Hemoglobin in Mice

An extract from the plasma of rabbits made anemic by phenylhydrazine, when injected subcutaneously into normal rats, has been found to produce increases in red-cell counts, in reticulocytes, in hemotocrit values, and in hemoglobin concentration (*1*). Extracts, previously tested on rats, have also been found effective in mice when they were given in larger doses. This result makes it appear likely that the polycythemic principle in anemic rabbit blood is effective generally in animals.

Preparation 2, Table 1, was made from a batch of plasma extract that gave a polycythemic response in rats. It was concentrated to one-half its original volume under reduced pressure at about room temperature. It was injected subcutaneously for 20 days into four Swiss albino mice of 33-g average weight. Each mouse was given 1 ml daily of the concentrate; this is equivalent to a dose of the unconcentrated material of 6 ml/100 g of body weight. When injecting rats, we used 2 ml/100 g. The dose ratios are shown in Table 1. Preparation 1, a control, was made in the same way as preparation 2, but from the plasma of normal rabbits. It was also injected into four mice, for 27 days, at three times the dose used for rats, calculated per gram of body weight. Preparations 1 and 2 were hypertonic. Preparation 3 was made from the same lot of plasma as preparation 2, first by concentration and then by dialysis at 4°C against distilled water to make the final concentration isotonic. It was injected into four mice in an amount corresponding to seven times the dose used for rats, per gram of body weight. Preparations 2 and 3 produced increases of hemoglobin; the control extract 1 had no effect. We have not found any activity in extracts of plasma from normal rabbits. As with rats, when the injection of active material is stopped, the hemoglobin concentration returns to its original normal value (*2*).

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2. This investigation was supported by research grant Nonr-220(09) from the U.S. Office of Naval Research.

4 June 1956

Table 1. Effect of different plasma preparations on mice. Average hemoglobin before and after injection (g/100 ml). The dose ratio was calculated as the amount of material injected per unit of body weight.

Preparation No.	No. of mice	Dose ratio (mouse/rat)	Days injected				
			0	7	14	20	27
1	4	3	15.7		15.6		15.5
2	4	3	14.3	15	17.5	18.2	
3	4	7	16.2	17.6	19.9		

Effect of Tranquilizing Drugs on Fighting Response of Siamese Fighting Fish

With the development of psychotherapeutic agents, the need for a simple, inexpensive method for their evaluation at a behavioral level has become extremely acute. Some measure of success has been achieved by determining their effectiveness in suppressing a conditioned emotional response of fear or anxiety in rats and monkeys (*1*). In view of the fact that tranquilizing drugs, such as reserpine and chlorpromazine, tend to diminish aggressiveness in untamed animals, and, particularly, since they are presumed to act at subcortical levels, it seemed worthwhile to explore the effects of such agents on the inborn pugnaciousness of the Siamese fighting fish, *Betta splendens* (*2*). Previously, the effect of lysergic acid derivatives on these fish had been studied in detail (*3*).

The fish normally respond to one another by exhibiting a characteristic fighting stance, which involves the expansion of the pectoral fins and branchial membranes, and by viciously attacking one another, often to the point where one is killed (*4*).

Sexually mature male fish, all exhibiting the fighting response, were used in the present study. A total of 48 fish were used, and only in instances where the animals showed complete recovery after 10 days were they used again. In the case of each drug studied, only fresh animals were used (*5*).

The results represent the independent conclusions of all the observers, and only those results for which agreement was unanimous are reported. The experimental aquarium (rectangular) was made of an opaque plastic and divided into two chambers separated by a watertight transparent Lucite panel and a removable opaque panel. After the experimental fish had been sufficiently exposed to the drug, which was dissolved in one chamber, the sliding panel was removed, and the fighting response was observed. Whenever the response appeared to be negative, the experimental fish was placed directly in the control chamber for further observation. The results are shown in Table 1.

In addition to the tranquilizing agents, a number of pharmacologically related substances were tested, such as narcotics, sedatives, antihistaminics, and analgesics. On the basis of the fighting and other behavorial responses, the drugs seem to fall into four distinct groups: the reserpine-Meprobamate, the chlorpromazine, the antihistaminic, and the barbiturate classes.

Reserpine and Meprobamate were studied in doses of 1, 2, 5, and 10 μg/ml. The fish refused to fight, exhibited backward swimming movements, and showed no attacking response. However, they remained active, swam about, and had normal appetites. Complete recovery occurred in 48 to 96 hours. After being exposed for a few minutes to a dose of 2 μg of chlorpromazine per milliliter, the fish became sedated and assumed a "Cartesian diver" position (*3*). They were, however, reactive to stimuli and remained inactive until they were attacked by other fish, whereupon they swam away. Chlorpromazine sulfoxide, the detoxification product of chlorpromazine, produced no behavioral changes in concentrations up to 50 times greater than those of chlorpromazine.

The fish that were exposed to the antihistaminic drugs not only failed to show the fighting response, but tried to escape from and to avoid the attacking fish. They remained quiet until they were exposed to a fighting fish, from which they escaped with such violence that they frequently almost jumped out of the tank. This behavior was altogether different from the behavior of the tranquilized fish, which retreated rather slowly (and deliberately) from an attacking fish. The normal response to a female fish, which is characterized by graceful swimming movements and is accompanied by the fighting stance, was absent in fish exposed to the antihistaminics. When two fish that had been treated with the antihistaminics were placed together, they equally avoided one another, and neither exhibited the normal fighting stance. The action of the antihistaminics lasted a very long time, and even after a week in fresh water, the fish exhibited a similar response. Another peculiarity was that they became pale upon exposure to a control fish exhibiting the fighting response. When the fish were again isolated, their color would return. This effect could be seen 4 days after a single 1-hour exposure to the drug.

The barbiturates produced a definite sedative effect. After 2 hours in sodium phenobarbital, the fish rested on the bottom, but showed the fighting response when goaded. With thiopental, the fish were actually narcotized; but they could be readily aroused and would orient themselves temporarily toward the control fish as if to fight, and then relapse into a depressed state.

In sodium salycilate, the fish behaved normally, and perhaps slightly hyperexcitably. Morphine, in concentrations up to 40 μg/ml, had a somewhat similar effect, and, if anything, increased ag-

Table 1. Effect of various drugs on Betta splendens.

Drug and class	No. of fish	Concn. (μg/ml)	Onset of action (min)	General action	Fighting response	Type of behavior when confronted with normal fighting fish
Reserpine (tranquilizer)	8	10	120	Very slight depression	No	Retreated, usually backward; refused to fight
Meprobamate (tranquilizer)	5	10	120	Very slight depression	No	Retreated, usually backward; refused to fight
Chlorpromazine (tranquilizer)	8	2	10–60	Strong depression	No	Quiescent, but retreated when attacked; refused to fight
Chlorpromazine sulfoxide (detoxification product of chlorpromazine)	3	50		No action	Yes	Showed fighting response
Phenergan (antihistaminic)	2	20	2	Depression	No	Retreated very rapidly
Pyribenzamine (antihistaminic)	3	20	2	Slight depression	No	Retreated rapidly
Benadryl (antihistaminic)	3	5	30	Depression	No	Retreated very rapidly
Atarax (antihistaminic and sedative)	3	20	45	Slight depression	No	Retreated very rapidly
Sodium phenobarbital (hypnotic)	2	30	90	Depression	Yes	Will fight; quiescent
Sodium thiopental (hypnotic)	4	20	35	Strong depression	Yes	Will fight; quiescent
Morphine sulfate (sedative and analgesic)	2	40		Slight excitation	Yes	Will fight; very aggressive
Sodium salicylate (analgesic)	3	400		Slight excitation	Yes	Will fight; very aggressive

gressiveness. In all the experiments, recovery was complete, and there were no mortalities.

Although preliminary observations would indicate that *B. splendens* responds differently to a diverse number of pharmacological agents, the tranquilizing agents do seem to induce a characteristic response. All such agents definitely suppressed the quality of pugnaciousness without necessarily impairing sensitivity and motor activity. It is felt that this preparation can be used in the partial evaluation of the tranquilizers, as well as related neurotropic agents.

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27 July 1956

Extracellular Deoxyribonucleic Acid of Bacteria and a Deoxyribonuclease Inhibitor

The slime layer of bacterial cells is an extracellular accumulation of viscous material, most commonly composed of some high-molecular-weight polysaccharide. Smithies and Gibbons (*1*) found that the slime layers of various halophilic bacteria contain deoxyribonucleic acid (DNA). The slime could be dispersed by the action of pancreatic deoxyribonuclease (DNase), with the liberation of soluble DNA-split products, without affecting cellular viability. More recently, the viscosity of the ropy sediments produced by a number of nonhalophilic bacteria has been shown to depend likewise on the presence of polymerized extracellular DNA (*2*). Investigations of *Brucella* (*3*) indicate the presence in certain cultures of extracellular DNA that is sufficiently polymerized to produce a fibrous precipitate in ethanol (*4*). Because of the interest attaching to the extracellular accumulation of a supposedly intracellular gene-associated type of material, DNA was isolated from cultures of various bacteria by methods designed to leave the cells intact. In further investigations (*5*), a mechanism leading to the accumulation of DNA slime was found to be the production of extracellular ribonucleic acid (RNA), which is capable of inhibiting DNase action.

Slime-layer DNA preparations were obtained from *Micrococcus citreus, M. pyogenes* var. *aureus* (three strains), *Alcaligenes faecalis* (two strains), *A. viscosus,* and three strains originating as laboratory contaminants, which were notable for their massive accumulation of slime. Of these, strain B is a species of *Pseudomonas* and strains C and E appear to be members of *Flavobacterium. Micrococcus pyogenes* var. *aureus,* which is pathogenic for human beings, grows readily in mediums containing 7.5-percent NaCl (1.3*M*) but usually is not considered to be a halophile. The other bacteria were considerably less salt tolerant, their growth being inhibited by 1.25*M* NaCl, and maximum growth was obtained only in broth containing less than 0.25 to 0.5*M* NaCl.

Micrococcus pyogenes var. *aureus,* which produces large quantities of an extracellular DNase under certain conditions (*6*), formed visible slime in young nonaerated brain-heart infusion (Difco) cultures; more massive accumulations were obtained when 1*M* NaCl was present or when the broth was buffered at *p*H 6.0 (succinate, 0.05*M*)—procedures designed to minimize DNase action. The other bacteria formed DNA slime under various conditions; commonly, a peptone-yeast extract broth was used. Cultures were harvested, usually after 2 to 4 days, by aspirating off the nonviscous broth from the mass of slime-covered cells. The slime was stirred with 0.41-percent sodium dodecyl sulfate for 3 hours, and NaCl was added (final concentration 1*M*) with further stirring. The viscous mixture was centrifuged and cells, which were revealed to be intact by microscopic examinations, were discarded. Nucleic acid was precipitated from the supernatant by addition of ethanol. Yields at this stage from strains B and C were commonly 200 mg of crude, dry product (containing 40 to 45-percent DNA) per liter of broth culture. One or two additional steps of purification with detergent were carried out (*7*).

Curves of the ultraviolet absorption spectra for solutions of each slime-layer preparation were quite similar to the curve obtained using thymus DNA; maxima for all occurred between 256 and 259 mμ. Comparisons of deoxyribose (*8*) and phosphorus values indicated that, with preparations from *Micrococcus citreus, Alcaligenes faecalis,* and strain B, more than 95 percent of the nucleic acid was DNA. The other preparations, however, showed considerably higher proportions of RNA (*9*). Furthermore, ratios of phosphorus to dry weight indicated that about half of each sample consisted of phosphorus-free ultraviolet-nonabsorbing material, believed to have been mainly polysaccharide (*9*).

Although the microbial preparations were not pure DNA, the viscosity of the solutions was practically the same as that of solutions of thymus DNA (*7*) having equivalent deoxyribose (Dische reaction, *8*) content. By means of small Ostwald-type viscometers (*10, 11*), determinations were made of the rates of viscosity reduction by crystalline pancreatic DNase (Worthington) of each of the slime-layer preparations and of thymus DNA. The reaction mixtures at 37°C contained 10^{-6} mg/ml of pancreatic DNase, 0.8 to 1.2 mg/ml of DNA, and imidazole buffer at *p*H 7.3, with 0.025*M* $MgCl_2$. The rates of depolymerization were essentially the same for all the samples (and their viscosities were reduced to that of water in each case, except *Alcaligenes viscosus*), thus verifying the presence of highly polymerized DNA.

Such DNA could not accumulate in the presence of active depolymerizing enzyme. Investigations of strain B showed that, under certain conditions, broth cultures may evidence depolymerizing activity when tested against thymus DNA but little or no activity against strain B DNA. This suggested that strain B and possibly the other bacteria also, may produce a deoxyribonuclease inhibitor (*11, 12*).

Table 1 shows the effects of treating strain B DNA with crystalline ribonuclease (RNase, Worthington), which was found to be free of DNase activity. The DNase of strain B, which resembles pancreatic DNase in being activated by Mg at *p*H 7.3, was obtained from cells (shaken with ballotini in a Mickle disintegrator) of a young culture. Using a fresh dilution (1/20 in 0.1-percent gelatin) of this disintegrated-cell preparation each time, parallel viscometric tests were carried out with DNA from two sources.

Table 1. Effect of ribonuclease on susceptibility of a preparation of slime-layer DNA to the subsequent action of DNase.

RNase treatment of strain B DNA (before adding DNase)		Activity (units) of strain B DNase against	
RNase (mg/ml)	Time incubated (min)	Strain B DNA	Thymus DNA (control)
No RNase treatment		1.3	12
5×10^{-4}	1	10	13
	120	12	12
1×10^{-5}	2	7	13
1×10^{-6}	7	6	13
1×10^{-7}	2	1	12
	65	2	12
	2880	6	13

Exposure of strain B DNA to 5×10^{-4} mg/ml of RNase for 1 minute before testing allowed the DNase to exhibit 10 units (instead of 1.3 units obtained in tests without preliminary RNase treatment), or 77 percent of the activity which it showed against thymus DNA. (If, in addition, the DNase preparation itself was subjected to RNase action, a higher DNase activity was demonstrated.) Lower concentrations of RNase also evidenced some inhibitor-destroying capacity, justifying the conclusion that this DNase inhibitor is a ribonucleic acid.

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15 June 1956

Second Pain: Fact or Artifact?

The phenomenon of "double pain," two temporally discrete and sometimes qualitatively different responses to a single noxious stimulus, has been reported intermittently for the past 75 years. Although there is a good deal of evidence that the phenomenon may be an artifact, it is accepted as genuine by many physiologists. Sinclair, who has been associated with much recent work on second pain, has concluded that it needs reinvestigation (*1*).

The problem is not simple. There are two quite separate and distinct aspects —sensation, a psychological term implying awareness, and afferent impulses, a physiological phenomenon revealed by electric recording techniques. These are often treated as though they were one and the same thing—indeed, it has recently become the fashion to speak of "C-fiber pain." The first question to be asked is whether there is a genuine sensory phenomenon that can be called "second pain." The present experimental data bear on this question only.

The experimental work consisted of three successive attempts to elicit double pain by stimulation of cutaneous receptors of the arm. In the first series, contact heat thresholds (time for a known temperature) were determined for eight subjects for hand, forearm, and elbow. In about one-fourth of the trials, two pains could be inferred—either one brief flash (which disappeared before the subject could respond) followed by a second pain, or fluctuation in the intensity of the pain. It seems obvious that any stimulus of this nature is essentially uncontrolled at the receptor level, and that heat continues to penetrate deeper into the tissues and to stimulate more remote receptors as well as deeper ones, even after the stimulator is removed. For this reason, no further work was done with this type of stimulus. The literature shows this to be one of the most effective stimuli in eliciting double pain.

In the second series, mechanical pain thresholds for three spots on the dorsal forearm were first determined for eight subjects. A rigidly-mounted needle algesimeter, calibrated in ¼-g steps, was used. The needle was sharpened under a microscope to minimize the stimulation of pressure, a probable reason for some of the reports of double pain, as von Frey contended (*2*). No double pains were reported. Adaptation trials at threshold and at 1 g above threshold (thresholds range from 2.5 to 5.0 g) were made. The course of adaptation showed fluctuations. In about one-fifth of the trials, there were only two peaks, which naive observers might possibly have interpreted as double pains, although ours did not. This work was repeated with four subjects who were highly practiced in psychophysical observation, using three spots on the dorsal forearm and three spots on the dorsal aspect of the middle finger. Additional adaptation trials were made at 2 g above threshold. Again no double pains were observed.

It is common knowledge in psychophysical research on pain that the stimulus must be unvarying. This would rule out handheld needles and similar apparatus, the sort of equipment which appears frequently in positive reports of double pain. If one permits the needle to remain in place, one finds fluctuations in sensation, as illustrated in the preceding paragraph. If one pulls it out, one has restimulated the receptor, as shown electrophysiologically by Zotterman (*3*). These phenomena will be intensified with suprathreshold stimuli. At or near threshold, double pains are not reported for mechanical stimulation. Where thresholds have not been experimentally determined (in the majority of studies), reports of double pain are suspect.

A further difficulty besets mechanical stimulation with suprathreshold stimuli —namely, the possibility of stimulating two discrete receptors sequentially. The fact that it takes appreciable time for a needle to penetrate to its maximum depth (*4*), makes this possibility very real. When our four experienced subjects were requested to observe carefully for a possible double pain and then were stimulated with suprathreshold stimuli, there were four reports of double sensations out of 20 trials. But two of these involved other cutaneous senses; one was cold and pain, and one was pressure and pain. Only two were double pains. This lends support to the hypothesis that two discrete receptors may be stimulated at different times under these conditions.

The third series consisted of 120 electric pain thresholds on the dorsal forearm for the group of four experienced subjects. A square-wave pulse from a Grass stimulator was used, the duration being physiologically infinite. There were no double pains, and no single, delayed pains.

In many ways, electric stimulation is less subject to artifacts than other kinds —at least, the time of action of the stimulus is constant, so that if two receptors are stimulated, they are stimulated simultaneously. In addition, it is possible to stimulate pain without the concomitant arousal of other cutaneous senses. It is significant that no experimenter has reported double pain with a single electric stimulus. Since all other senses are stimulable electrically, it seems difficult to believe that if there is a second, slower pain system leading to sensation, it would not appear in 480 separate determinations. The argument that a second pain system is suppressed by the faster system lacks evidence.

Double pain was not found with normal subjects under controlled conditions. Landau and Bishop also obtained somewhat similar results with their normal subjects (*5*).

Other lines of evidence have been thoroughly reviewed recently (*6*). One of the prime lines of evidence for double pain has been the order of loss of sensations during nerve blocks. Careful experimentation on several different areas, coupled with statistical analysis of the significance of the order of loss, shows this evidence to be unreliable (*6, 7, 8*).

A second line of defense has been the delay in pain perception under ischemic conditions, often interpreted as a dropping out of one pain system while a

second is spared. But it has been shown that all the cutaneous senses show this increasing delay in perception under these circumstances (*8*, *9*).

A third argument has been based on reaction time: presumably, the reaction time to "delayed" pain in the extremities corresponds to the conduction time for the C fibers. In a recent study involving a larger number of trials, coupled with statistical analysis of results, reaction time could not be related to distance from the central nervous system, probably because of the large number of uncontrolled variables (*10*).

Several other lines of recent evidence (conduction rates of fibers subserving slowly adapting touch versus hair touch fibers, strength-duration curves for pain) are also negative. The best evidence of all varieties points to double pain as an artifact. Positive reports appear to be due to inadequate experimental control, particularly with regard to control of the stimulus and psychophysical methods, and to lack of statistical analysis.

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4 June 1956

Marine Borer Attack on Lead Cable Sheath

The activity of molluscan borers on such materials as wood, cellulose fibers, rocks, and shells is extensively documented. However, reports in the literature regarding their attack on metals are uncommon. Only two references (*1*, *2*) on this subject have come to our attention. Both of these refer to the penetration of lead—one (*1*) by *Martesia* (*Diploplax*) *funisicola*, a member of the family Pholadidae and the other (*2*) by one of the Teredinidae, *Teredo navalis*. In view of this limited information, it seems desirable to document a recent case in which a mollusk penetrated a lead-sheathed submarine telephone cable.

The cable which was attacked belongs to the Southern Bell Telephone and Telegraph Company and lies in the Ortega River at Jacksonville, Florida. The sheath of the cable is composed of a solid lead covering approximately 4 mm thick. Over the lead sheath are two layers of asphalt-impregnated jute which serve as bedding for a single layer of galvanized steel armor wires.

The cable was placed in service in 1927, and the present trouble occurred in 1955. Attack occurred at a point approximately 350 ft from the shore, at a depth of about 3.5 ft. The river bottom at that location was muddy.

At the point where penetration occurred, the armor wire had rusted away, leaving the lead sheath exposed. Two holes had been bored in the sample of damaged sheath received at Bell Laboratories. One hole completely penetrated the lead, while the other had barely punctured the inside face of the sheath. The general appearance and detail of the damaged area are illustrated in Fig. 1 (*3*).

The dimensions of the holes suggest that they were caused by a member of the family Pholadidae. At the point of entry, both holes are slightly elliptical. In one case, the diameter is 3.5 mm at the widest point and 3.0 mm at the narrowest. In the second case, the dimensions are 3.0 and 2.5 mm, respectively. As the tunnels progress inward, the diameters increase until, at a depth of about 2 mm, they are each approximately 5 or 6 mm. In the case of the hole which completely penetrates the sheath, it is doubtful that the organism progressed through the inside surface, since the greatest diameter at that point is only 2.5 mm.

In Fig. 2, a photomicrograph of the interior of the shallower hole, striations in the lead resulting from boring action are readily apparent. In some cases, minute lead shavings were observed, where the rocking action of the shells had peeled off the substrate. The closely crosshatched pattern of the striations is illustrative of the rocking and heaving motion described by Turner (*4*) as characteristic of the valves of *Barnea truncata* and *Martesia striata*. Although it is not readily apparent in the photomicrograph, small bits of mineral that resemble quartz crystals in appearance are imbedded in the lead, particularly in the wall of the hole. As suggested by Turner (*4*), the presence of such hard particles around the anterior portion of the valves may be

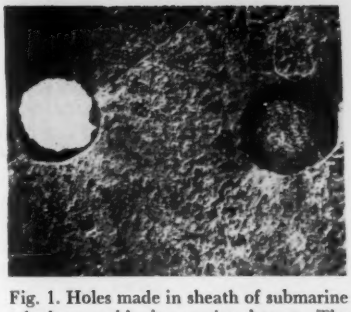

Fig. 1. Holes made in sheath of submarine telephone cable by marine borers. The hole on the right has barely broken the inside surface of the sheath (×5).

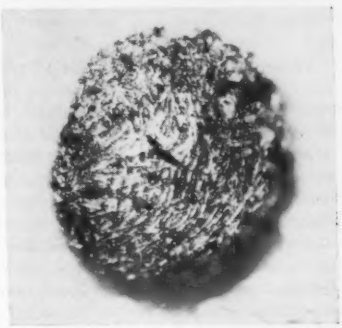

Fig. 2. Striations on the face of the hole in lead sheath caused by rocking action of the shells of the borer (×12).

of material aid in boring. No information is available concerning whether the jute that underlies the armor wires was present in the damaged area when the attack occurred. It is conceivable that the organisms obtained their start in the jute and progressed into the lead.

Although the attack of metals by mollusks is indicated by existing data to be unusual, it is evident that penetration may occur in lead.

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28 May 1956

In defense of accuracy we must be zealous, as it were, even to slaying.—P. G. TAIT.

Book Reviews

Grasslands of the Great Plains. Their nature and use. J. E. Weaver and F. W. Albertson. With special chapters by B. W. Allred and A. Heerwagen. Johnson, Lincoln, Neb., 1956. 385 pp. Illus. $6.50.

With the exception of some 20-odd opening pages of general discussion, the reading of this companion volume to Weaver's *North American Prairie* [*Sci. Monthly* **80**, 262 (1955)] is pretty much an inductive experience. The characteristics of more than a score of important plants are reviewed, the vegetation of western Kansas is described and followed through a climatic cycle, the process is repeated on a more regional basis, then conditions in some ten representative areas are examined, with a pause to consider the underground characters of more than 2 dozen significant plants. At the end is a chapter on nongrasses, emphasizing their valuable role.

If the indolent reader objects to this routine, let him remember that he is being expertly guided on a vicarious field trip. What he can learn at the price of a few days' concentration would otherwise have cost him long months of arduous exertion, physical and mental. Should he be one of those whose living is derived from the hazardous environment of the Great Plains, he will find much that is to his advantage to know, if he has the wisdom and restraint to use it. If his interest is mainly scientific, he will gain greatly in insight.

The vegetation of the Great Plains seems to have had its inception in the Miocene, some 20 million years ago. For this there is sound paleontological evidence, contravening the ideas of Sauer and others on the origin of grassland through fires set by primitive man.

The semiarid grasslands, we are reminded, represent the greatest expanse of grassland on the continent. Except for their plateau extension in the Southwest, they are practically coterminous with the Great Plains; hence, the title of this book. Lying west of the True Prairie, or as some would prefer to call it the (subhumid, tall-grass) Prairie proper, the more arid grasslands extend on west to the Rocky Mountains, and north from Texas into Canada.

For these latter, the authors, following Clements, propose the name "Mixed Prairie" rather than the older term "Short-Grass Plains," basing their action on the appearance of mid-grasses along with short grasses when conditions are favorable. Aside from the historical fact that Prairie as first seen and christened by the French was the subhumid tall-grass community, there is the indubitable presence of a transition belt of some 100 miles in width, composed of both tall and shorter grasses and lying between the subhumid and semiarid communities. Some workers would prefer to see the name "Mixed Prairie" reserved for this interzone.

An interesting question is also raised by the authors' virtual elimination of the short grass as a climax type in its own right. Granting that the mid-grasses flourish under protection and under favorable soil and moisture conditions, it could be urged that neither of these ideals was general and continuous under natural conditions. Generally speaking, the short grasses are southern in origin, the mid-grasses are northern, more vulnerable to grazing and drouth, both of which were normal to the environmental complex that, by and large, must have determined the point of climax equilibrium.

The significant fact, regardless of terminology, is the great natural diversity of species and ecological types, beautifully adjusted to one another and to the vicissitudes of climate and soil. With such a resilient and persistent character, ready when possible to move beyond the equilibrium level, or to take refuge below it if need be, small wonder that there are differences of opinion with respect to a suitable terminology.

This amazing vitality of the short- and mid-grass community, which it shares with the tall-grass prairie, seems to me to be the essential theme of the book, overwhelmingly demonstrated. It rests not only upon the variety of species present and their complementary relationships but upon genetic variation within the species. One is surprised, therefore, to find no mention of Olmsted's work on regional segregates in *Bouteloa* or of the recent study in Nebraska of physiological differences of different clones of the same species growing in the same local community.

But if Weaver and Albertson have shown the recuperative power of grassland under normal adventures such as fire, drouth, and grazing by the natural fauna, they have shown with equal clarity how vulnerable it is to continued misuse by man. Even better they have shown that wise and moderate use is possible and, in the end, the most profitable course. Their demonstration of the maximum value of the natural grasslands for judicious grazing makes their book an important economic, no less than scientific document.

The late lamented Kirk Bryan was highly skeptical of the relation of overgrazing to erosion and was equally dubious of the claims made for the superior forage value of natural, especially climax, vegetation. A few weeks before his death he told me that he stood ready to change his mind anytime the evidence justified it. I am sorry not to have had a chance to discuss *Grasslands of the Great Plains* with him.

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Psychoanalysis and Psychotherapy. Developments in theory, technique, and training. Franz Alexander. Norton, New York, 1956. 299 pp. $4.75.

Ten years ago, Alexander and his colleague, Thomas French, published (in *Psychoanalytic Therapy*) an account of the experimental modifications of methods of psychoanalytic treatment which they and their Chicago colleagues had been trying for more than 8 years. It immediately aroused a vigorous controversy in psychoanalytic circles, which has continued for some years. In the present book, Alexander restates his position, buttresses it, and answers his critics. One of the main criticisms has been that Alexander's type of treatment is psychotherapy, not psychoanalysis. This argument is discussed with a full awareness that it is a matter of definition, yet one that carries a heavy freight of implications for prestige, income, and professional identification. It raises knotty professional issues: distinguishing the various techniques of psychological treatment that are based on a psychoanalytic understanding of personality, determining their differential usefulness in various pathological conditions, and training psychiatric therapists to carry them out.

The book opens with a literary-historical essay on the plight of mankind and the role that psychoanalytic psychotherapy plays in it. Alexander then restates the Freudian theory of the treatment process, discussing his additions to

it as well as those of several other analysts who have proposed modified techniques. Two chapters are taken up with the therapeutic consequences of a defensive stratagem encountered in some patients: bringing in material from a period in their lives earlier than the time of the pathogenic experiences. The devices of cutting down the frequency of appointments or temporarily interrupting the treatment help overcome this obstacle, Alexander says.

One of the most interesting parts of the book is the collection of answers to a brief questionnaire that Alexander sent to a number of the leading figures in psychiatric and psychoanalytic education. These contain many thoughtful statements about the difficulties of sensibly differentiating the teaching of psychiatric residents and of psychoanalytic candidates. Now that psychoanalytic theory is such an integral part of psychiatry, a number of teachers frankly bring into the open their doubts about present traditions and methods of training for psychoanalysis and psychotherapy, and a few of them point out the need for better research training in these fields.

On the whole, the book will be of most interest and value to psychoanalysts and psychotherapists who are concerned with understanding their techniques of treating patients and training future colleagues. The onlooker from other disciplines who is primarily interested in the scientific and theoretical aspects of psychoanalysis and psychotherapy will find little here that is directly nutritive, although there is a good deal that can help him to understand the idiosyncrasies of psychoanalysis as a science.

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Bacterial Anatomy. Sixth symposium of the Society for General Microbiology held at the Royal Institution, London, April 1956. E. T. C. Spooner and B. A. D. Stocker, Eds. Cambridge University Press, Cambridge, England, 1956. 360 pp. Illus. + plates. $6.

This book is a stimulating addition to the literature. It is technically descriptive, analytic, and often provocative, according to the spirit and wit of the individual and highly competent authors. The 15 articles were published before the symposium, so that discussion could be the main business of the meeting. The book could well serve to repeat the original and admirable intent of the society as a basis for discussion in many laboratories around the world.

The first half of the book might be considered an extension of the initial symposium of the series [*The Nature of the Bacterial Surface* A. A. Miles and N. W. Pirie, Eds. (Blackwell, Oxford, 1949)] and reflects much of the most provocative ensuing work on superficial structures—for example, flagella (B. A. D. Stocker). Contributions on the characteristics and capabilities of protoplasts (C. Weibull and K. McQuillen), osmotic regulation (P. Mitchell and Jennifer Moyle), the nature of cell walls (M. R. J. Salton), and an ingenious immunological analysis of the distribution of constituents in complex capsules (J. Tomcsik) clearly underline a current direction of attention to the physical and chemical nature of cell surfaces and to the definition of the structure and functions of these regions. These lucid articles represent analytic approaches, mainly biochemical, with important structural overtones. A description of the crystalloid protein and other inclusions found in certain *Bacillus* sp. during sporulation is a fascinating contribution (C. L. Hannay) and points to new areas of study. The toxic role of these inclusions in insect disease has been demonstrated.

The complex and often confusing literature on the form and division of bacterial chromatin structures is considered in two vigorous and philosophically dissimilar articles. On the one hand, C. F. Robinow describes the behavior of chromatin bodies, discusses their cytological status in general biological terms, and argues strongly for differentiation (in properties, behavior, and descriptive terminology) of chromatin bodies from analogous organelles in most other kinds of cells. On the other hand, E. D. DeLamater assumes the acceptability of a mitotic process of chromosomal separation in a bacterial nucleus, describes his observations in those defined terms, and cites synchronization experiments, which he feels support his case. Helpful for those following these differences of approach and interpretation is an appended section to Robinow's article examining "the alleged evidence of mitosis in bacteria." One might have hoped that the general article on "Chromosomes in micro-organisms" (C. G. Elliot) would give a more useful perspective from outside the field of battle, but the pronouncements are not particularly illuminating.

The uncertainties of preservation involved in preparation for ultrathin sectioning and electron microscopy are clearly defined by O. Maaløe and A. Birch-Andersen. These authors describe a new epoxy resin imbedding technique that may be of good use. Their paper and the deceptively persuasive prose of J. R. G. Bradfield concerning cytoplasmic organization really emphasize that we are not yet in a position to interpret the fine structure of the bacterial protoplast, but they are nevertheless helpful assessments of our current state.

This book will be a source of information and enjoyment to bacteriologists, to the biologist who would like to examine "the resemblances of things," and to the advanced student who would like to stray from the strict confines of course-work.

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Ultrasonic Engineering with Particular Reference to High Power Applications. Alan E. Crawford. Academic Press, New York; Butterworths, London, 1955. x + 344 pp. Illus. $8.

This book contains a survey of current practice in the use of vibration, sound, and ultrasonics of high amplitude for practical purposes. It also provides a review of pertinent scientific literature, suitable for orientation of the would-be user. An extensive, but nevertheless carefully selected, bibliography follows each chapter.

The author is successful in presenting a large amount of useful and interesting material at a satisfying scientific level without use of mathematics beyond simple algebra. Two chapters contain general introductory acoustical facts and a 20-page discussion of cavitation phenomena. In four chapters a good deal of practical data is given on transducers and generators now in use. Six chapters treat applications of high-amplitude sound and ultrasonics; detailed information is given on *precipitation and agglomeration, emulsification and dispersion, chemical applications, metallurgical applications, coating of metals* (*soldering*), and *biological applications.* A final chapter treats applications of sound for measuring and testing (rather than producing changes in) materials.

This book will be a very good one for that wide audience of persons, not specialists in acoustics and ultrasonics, who wish to know the possibilities of high-amplitude sound for their application. The specialist will also find much useful information here but will want to complement this source with others, especially for the necessary mathematical theory.

A small lament might be entered. The title follows a common departure from standard terminology in its use of the adjective *ultrasonic.* The latter should refer to sound whose frequency is above the audible range, whereas the subject of this book naturally involves sound of *all* frequencies, since many of the effects

discussed occur just as well at low frequencies as at high. The qualifying adjective needed is one indicating sound whose *amplitude* is high. Pending standardization of such an adjective (*hypersonic* and *macrosonic* have been suggested), it appears necessary to refer to an agent identified somewhat prosaically as "high-amplitude sound."

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The Myology of the Whooping Crane, Grus americana. Illinois Biological Monographs, vol. XXIV, No. 2. Harvey I. Fisher and Donald C. Goodman. University of Illinois Press, Urbana, 1955. 127 pp. Illus. Cloth, $3.50; paper, $2.50.

It is curious indeed that, although birds are probably better known taxonomically than any other group of animals, and although descriptive and comparative anatomy are among the oldest of the zoological sciences, the anatomy of birds is poorly known. It has been generally assumed more or less tacitly that all birds are essentially alike under the skin. As a matter of fact, as the authors of the present book observed, the musculature of only one bird, the raven, is known with any degree of completeness, and this description dates back to 1890. The lack of anatomical information about birds is all the more extraordinary because detailed studies about other kinds of vertebrates have proved invaluable in unraveling fundamental relationships. In view of the scarcity of bird fossils, such an approach would seem especially fruitful for students of avian phylogeny. It is thus gratifying that two competent investigators undertook a study of the myology of the whooping crane. Because the whooping crane seems destined for extinction in the near future, the work of Fisher and Goodman is timely, to say the least.

The Myology of the Whooping Crane, Grus americana is based on the dissection of three specimens, none of which was killed specifically for anatomical study. The bulk of the book is devoted to the detailed description of the crane's musculature. There follows a short "Discussion." The discussion, however, consists primarily of a summarization of the salient details of the text proper. The lack of a definitive interpretation of the findings is regrettable, but certainly understandable since this is virtually a pioneer study. Happily it sets a high standard for others to follow.

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The Biology of Senescence. Alex Comfort. Rinehart, New York, 1956. xiii + 257 pp. $4.

This book is a greatly expanded form of Alex Comfort's article, "Biological aspects of senescence" [*Biol. Revs. Cambridge Phil. Soc.* **29**, 284 (1954)]. In my opinion Comfort has made the first partial success in bringing together in a very readable and logical form the mass of biologic research in aging. The author acknowledges the fact that the book is incomplete; even so, the collating and attempts at evaluation of a large number of papers have presented to the investigator several problems that must be solved in order to get a proper picture of biologic aging.

A discussion of the attempts to measure senescence arrives at the conclusion that, at present, no method is satisfactory. The discussion concerning the distribution of senescence is very well developed, and most of the known information on various life-forms has been included. However, I have some doubt as to the value of this type of work in research in aging—but I keep asking myself this question: "Let us assume that we know the normal life-span of every life-form, its maximum found in nature per se, and the average under natural and laboratory conditions. How does this aid us in studying the processes of aging?" The treatment of senescence in protozoans has always been fascinating, and the effects of genetics on life-span certainly point to possible human application and interpretation of work in this field.

In the latter half of the book, Comfort gets down to our primary interests in discussing the work on growth and senescence and, the most interesting of all to me, the various mechanisms of senescence. The general conclusion may be that we must know a lot more before we can say "this is how an animal grows old." The problem of *why* is intimately bound up in the bioenergetic relationships of cells, tissues, and organs. The animal ages as a whole, but it is possible that the real mechanisms may lie in cellular aging.

Comfort is reserved in most of his conclusions, and his book is a must for any investigator in the fields of biologic aging. Comfort suggests that if nothing else of value comes from the book, the references will be useful. I am willing to go further and state that a careful reading of his book will help in organizing one's own knowledge and viewpoints in aging—not that I agree with him all the time, for this is asking too much of any book or any investigator.

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Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, *but to the publisher or agency sponsoring the publication.)*

Research at Cornell. Annual report of the vice president for research 1955–56. Cornell University, Ithaca, N.Y., 1956. 48 pp.

Twentieth Semiannual Report of the Atomic Energy Commission, July 1956. U.S. Atomic Energy Commission, Washington, D.C., 1956. 260 pp.

The Concept of Entropy in Communication, Living Organisms, and Thermodynamics. Research Ser. No. 130. Y. S. Touloukian. Purdue University Engineering Experiment Station, Lafayette, Ind., 1956. 66 pp. $1.

Fossil Mammals of Africa. No. 9. *A Miocene Lemuroid Skull from East Africa.* Wilfrid Le Gros Clark. British Museum (Natural History), London, 1956. 6 pp. 5s.

Atomic Energy of Canada Limited, Annual Report, 1955–56. Atomic Energy of Canada, Ltd., Ottawa, 1956. 20 pp.

Reproduction and Infertility. Physiology, anatomy, pathology, biochemistry. 27–29 June 1955, Michigan State University Centennial Symposium, sponsored by the College of Veterinary Medicine Agricultural Experiment Station, Michigan State University, East Lansing, 1956. 112 pp. $3.

Scientific Research Progress in Mellon Institute 1955–56. Annual Rept. Ser. No. 43. Annual report of the president, Edward R. Weidlein, to the board of trustees of the institute, for the fiscal year ended 29 Feb. 1956. Mellon Institute, Pittsburgh, Pa., 1956. 54 pp.

A Study of the Distribution and Taxonomy of the Percid Fish Percina Nigrofasciata (*Agassiz*) Tulane Studies in Zoology, vol. 4, No. 1. Tulane University, New Orleans, La., 1956. 55 pp. $0.75.

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Meetings and Societies

Malaria

The demonstration of remarkable antianopheline effectiveness of residually sprayed DDT, BHC, and Dieldrin during and immediately after World War II suggested the possibility of transforming national malaria control programs into rapid country-wide malaria eradication. Control usually means reducing the incidence of malaria—that is, holding it at a level that has little public health importance. It is a continuing attack with no foreseeable conclusion. Malaria eradication, on the other hand, implies the complete interruption of transmission and the elimination of the reservoir of infection by a campaign limited in time and carried out so thoroughly that there will be no resumption of transmission. The plasmodia are eradicated although mosquito vectors may remain.

Since 1945, nation-wide malaria eradication has been widely tested and found to be technically, financially, and administratively practicable in many places. Malaria has now been eradicated from extensive areas of Argentina, British Guiana, Ceylon, Chile, Cyprus, French Guiana, Greece, Italy, Mauritius, Taiwan, the United States, and Venezuela. Large eradication projects are also going forward in Indonesia, Iran, Madagascar, the Philippines, and Thailand, and in all the malarious countries of the Americas, on a regional basis. A second regional project, one embracing Europe and the Near East, is now being started.

A prime function of the World Health Organization is "to act as the directing and co-ordinating authority on international health work" (Constitution, Chapter II Article 2), and WHO had an important part in leading and stimulating the world-wide surge toward malaria eradication. Experience has shown that carefully focused regional and interregional conferences implement this function. Such conferences have been particularly useful in the development of national and regional malaria-eradication projects.

In order to accelerate the Europe–Near East scheme, the World Health Organization convened in Athens, Greece, in June an Inter-regional Conference on Malaria in the Eastern Mediterranean and European Regions. Of the member countries of these two WHO regions, Algeria, France, Greece, Iran, Israel, Italy, Morocco, Pakistan, Portugal, Spain, Turkey, the United Kingdom, and Yugoslavia sent representatives. Also attending and contributing notably to the discussions were malaria consultants from France, the United Kingdom, and the United States; the principal malariologists of Afghanistan, Brazil, Ceylon, India, Nigeria, Taiwan, Thailand, and Venezuela; WHO regional malaria advisers from the American, the Eastern Mediterranean, and Western Pacific regions; WHO field malariologists from Iraq, Saudi Arabia, and Syria; the WHO malariologist, UNRWA, Beirut; the parasitology adviser, USOM–Ethiopia (ICA); and representatives of the secretariats of WHO and UNICEF. Following the conference, which, because of the presence of Israeli delegates, was not attended by Arab officials, there was an advisory meeting on malaria eradication in Egypt, Iran, Iraq, Lebanon, Saudi Arabia, and Syria, to which each of the countries named sent representatives. The conference and advisory meeting benefited greatly from active participation of members of the sixth session of the WHO Expert Malaria Committee, which was held concurrently in Athens.

The subject discussed by the three groups was malaria eradication. The expert committee in closed meetings laid down general principles, preparing what will be an authoritative manual on the subject. The manual no doubt will be published by WHO in due time. The conference and advisory meeting discussed specific plans for eradicating malaria from Europe and the Near East, noting particularly the great desirability of achieving eradication before malaria vectors develop intractable resistance to residual insecticides.

The size of the problem in Europe and the Near East is suggested by the following data, which, although they are approximate, probably convey a reasonably correct idea of magnitude. Malaria is endemic in 14 European countries, excluding the Soviet Union: Albania, Bulgaria, Czechoslovakia, France (only in Corsica), Germany, Greece, Hungary, Italy, Netherlands, Poland, Portugal, Roumania, Spain, and Yugoslavia, having a total population of 308,945,000 (U.N. Demographic Yearbook, 1955). Approximately 42,491,000 Europeans live in areas now or recently malarious, and some 33,451,000 of this total benefit by routine antimalaria activities, the remaining 9,040,000 having sporadic protection or none at all. The population of the Near East, including Cyprus, Iran, Iraq, Israel, Jordan, Lebanon, Syria, and Turkey is 57,257,000 (U.N. Demographic Yearbook, 1955) of whom some 37,908,000 live in malarious areas. Approximately 19,757,000 persons are under some routine antimalaria protection, leaving some 18,151,000 unprotected. Egypt's population is 22,651,000; some 12 million are in malarious areas and some 8 million are under antimalaria protection. Corresponding figures for Saudi Arabia are 7, 6, and 0.85 million. Although no accurate data are available, one can estimate that more than 10 million clinical cases of malaria occurred in these European and Near Eastern countries in 1955, with about 100,000 deaths directly due to the disease. In numerous areas, malaria is a major retarding factor in social and economic development.

All endemic areas in Bulgaria, Cyprus, Czechoslovakia, France, Germany, Greece, Italy, and Roumania, and nearly all in the Netherlands and Yugoslavia are under antimalaria measures or surveillance. The diesase has low incidence in these countries. Malaria has been practically eradicated from Crete, Cyprus, and Italy, including Sicily and Sardinia. In Israel, Lebanon, Portugal, Spain, and Turkey the incidence of the disease has been greatly reduced.

The conference reviewed the situation reflected by the afore-mentioned data and devoted much attention to administrative, financial, technical, and training needs of malaria eradication projects in the two regions. It discussed measures for dealing with residual foci when malaria has been nearly eradicated; problems of *Anopheles* resistance to insecticides; the place of antimalaria drugs in eradication programs; the establishment of adequate surveillance systems to supplant active control when transmission has been interrupted; the enlightenment of public and professional groups concerning the aims, needs, and benefits of malaria eradication; general public-health policy in relation to malaria eradication; research needs, and the necessity for international coordination and correlation.

The conference concluded that malaria eradication is technically feasible in the two regions, although it recognized that administrative and financial difficulties prevailing in some of the countries might be a serious handicap and that in-

ternational assistance might be required. Finally, the conference expressed the hope that the countries of the two regions would work toward eradication.

PAUL F. RUSSELL
Rockefeller Foundation, New York

Physics Teachers

The summer meeting of the American Association of Physics Teachers was held this year 20–22 June in Toronto, Ontario. The host institutions were the University of Toronto and McMaster University in nearby Hamilton.

The papers on the first afternoon were invited papers by members of the Toronto faculty: "Reminiscences in physics, from 1895 on" by John Satterly, "Physics at low temperatures" by A. C. H. Hallett, and "Radio astronomy" by D. A. MacRae. The invited papers on the next afternoon included a masterly presentation by Philip Morrison (Cornell University) on the antiproton—the reasons that its existence was anticipated and the experimental evidence establishing its discovery.

The mornings were devoted to 10-minute contributed papers on various aspects of physics teaching. The paper stimulating the most discussion was that of W. W. Marsteller (Ursinus College) on "Archimedes and the floating needle," concerning which divergent opinions were expressed. The final paper was an amusing presentation by K. S. Woodcock (Bates College) on physics problems in the Lilliputian world that was created by Swift in *Gulliver's Travels*, such as the difficulty of pouring from Lilliputian goblets.

The after-dinner speech on the evening of the banquet was given by John P. Hagen (Naval Research Laboratory), who discussed the projected earth satellite, the difficulties that would be encountered in launching it, and the information that would be gained from such an experiment. On the remaining evening there was an informal showing of three movies on the atom by Edward Teller which had originally been produced on television.

On the final afternoon, the meeting moved to the campus of McMaster University, where those attending inspected the research and laboratory facilities. H. E. Duckworth (Hamilton College) gave an excellent lecture on the mass spectrograph. This included a demonstration with a highly colored model that made the fundamental working of the instrument intelligible and interesting to all, including the wives and children in attendance. In a 10-minute "postscript" to the lecture, Duckworth presented a brief summary of the latest results obtained with the mass spectrographs constructed and operated under his direction. This lecture was a superb finale to a consistently excellent meeting.

MILDRED ALLEN
Mount Holyoke College,
South Hadley, Massachusetts

Meeting Notes

■ A 3-day conference on Management, Economics and Technology for the Atomic Industry has been announced by the Atomic Industrial Forum, Inc., New York. The meeting will be held in Chicago, Ill., at the Morrison Hotel, 25–27 Sept. in conjunction with the 1956 Trade Fair of the Atomic Industry, which will take place at the Navy Pier, Chicago, 24–28 Sept. More than 100 exhibiting organizations will take part in the show.

The conference panels cover a wide variety of subjects of interest not only to technical and management people from the industry itself, but also to firms that are contemplating entry into the field either as suppliers of equipment and materials or as users of this new energy source. Panel subjects include: economics of power reactor systems, impact of atomic energy on the law, radiation utilization, new power reactor concepts, elements of nuclear power costs, insurance problems, new reactor projects, reactor materials, information requirments of the atomic industry, research programs and facilities, international developments, and impact of atomic energy on other fields.

The conference will be highlighted by three luncheons and a banquet. One luncheon speaker will be Willis Gale, chairman of the Commonwealth Edison Company. Franz Josef Strauss, Atomic Energy Minister for West Germany, will address a second luncheon, and the third will hear a discussion of "Atomic energy and the law." The last session is jointly sponsored with the Chicago Bar Association and the law schools of the University of Chicago and Northwestern University. The conference banquet will be addressed by Harold S. Vance, commissioner, U.S. Atomic Energy Commission.

■ The fourth biennial symposium on Organic Chemistry, sponsored jointly by the Philadelphia and Wilmington Organic Chemists' Clubs, will be held at the Du Pont Country Club in Wilmington, Del., on 24 Oct. The program will include George Buchi (Massachusetts Institute of Technology), "Recent novel reactions in organic chemistry"; Emil Schlittler (Ciba Pharmaceutical Prod-

ucts Company), "Chemistry of the tranquilizing drugs"; William F. Truce (Purdue University), "Stereospecific nucleophilic reactions on acetylenes and vinyl-type halides"; and William von E. Doering (Yale University), "Carbenes: organic chemistry of divalent carbon." For information write to Dr. Harry W. Turner, Hercules Powder Company, Research Center, Wilmington, Del.

■ The American Psychosomatic Society will hold its 14th annual meeting at Chalfonte-Haddon Hall in Atlantic City, N.J., 4–5 May 1957. The program committee would like to receive titles and abstracts of papers for consideration for the program no later than *1 Dec. 1956*. The time allotted for presentation of each paper will be 20 minutes. Abstracts, in sextuplicate, should be submitted to the chairman of the program committee, Dr. I. Arthur Mirsky, 551 Madison Ave., New York 22, N.Y.

■ A symposium on Optics and Microwaves will be held at George Washington University (Washington, D.C.), 14–16 Nov. The meeting is jointly sponsored by the Institute of Radio Engineers Professional Group on Antennas and Propagation, the George Washington University School of Engineering, and the Optical Society of America.

The technical program will consist of six sessions, each embracing a subject of general interest to all persons who deal with optical phenomena in research or application in the fields of engineering, medicine, or the related physical sciences. Survey and tutorial papers will be presented to encourage understanding of the basic physics underlying fundamental characteristics which relate optics and microwaves as the two concepts now exist. Advance registration for the meeting is $2.50 and may be made by mail to Symposium on Optics and Microwaves, Box 355, Falls Church, Va. Registration at the door will be $3.50.

■ Twenty-four technical sessions and three luncheon addresses of general interest will highlight the 1956 National Electronics Conference that will take place in the Hotel Sherman, Chicago, Ill., 1–3 Oct. More than 10,000 persons are expected to attend the 3-day technical meeting and exhibition, which has as its theme "Fifty years of progress through electronics."

Principal addresses will be given by John P. Hagen, director of the "Vanguard" project at the Naval Research Laboratory, Washington, D.C.; Frederick L. Hovde, president of Purdue University, Lafayette, Ind.; and Herbert Scoville, Jr., assistant director of the Central Intelligence Agency, Washington. Hagen will discuss earth satellites and space travel, and Scoville will compare United States and Soviet technical education policies. Hovde's subject has not been announced. For information write to Victor J. Danilov, Illinois Institute of Technology, Chicago 16, Ill.

■ Chemical advances against diabetes and cancer, progress in the cold sterilization of foods, and the latest developments in automotive lubricants will be reported at the 130th national meeting of the American Chemical Society, which will take place in Atlantic City, N.J., 16–21 Sept. Some 10,000 chemists and chemical engineers from all parts of the United States and several foreign countries will participate in the sessions.

Eger V. Murphree, special assistant for guided missiles in the Office of the Secretary of Defense, will address the society at a banquet on 18 Sept. Murphree, who is president of the Esso Research and Engineering Company, Linden, N.J., will discuss "Guided missiles and chemistry."

Other special speakers will be Gen. John E. Hull, U.S.A. (Ret.), president

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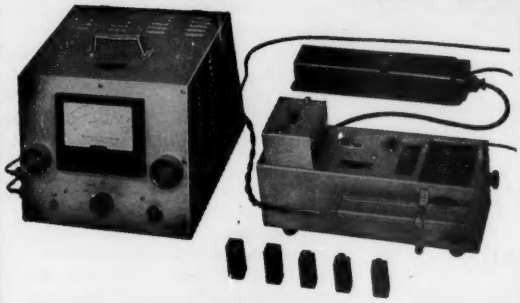

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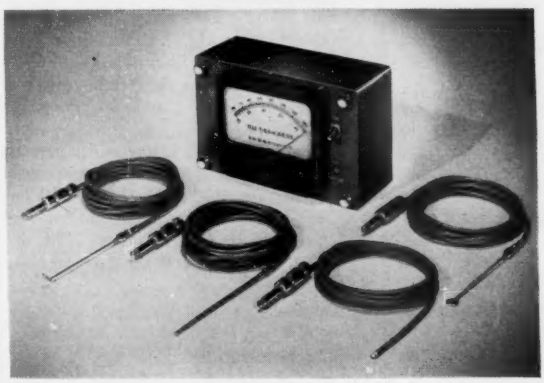

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of the Manufacturing Chemists Association; Bradshaw Mintener, Assistant Secretary of the Department of Health, Education and Welfare; Byron T. Shaw, administrator of the Agricultural Research Service in the Department of Agriculture; and Robert C. Watson, United States Commissioner of Patents.

John C. Warner, president of the society and president of the Carnegie Institute of Technology, will deliver the presidential address on 19 Sept. His topic will be "Is chemical education too specialized?"

■ Each year in conjunction with its annual meeting the American Cancer Society sponsors a scientific session. The subject of the session this year will be "Endocrines and cancer." The meeting will serve as a summarization, as well as a critical evaluation, of the etiologic and therapeutic role that hormones play in neoplastic diseases.

The program will consist of a series of discussions presented by investigators and clinicians from this country and abroad. Further details may be obtained from the American Cancer Society, Professional Education Section, 521 W. 57 St., New York 19, N.Y.

■ The American Nuclear Society has announced that a winter meeting of the society will be held 10–12 Dec. in the Sheraton-Park Hotel, Washington, D.C. This meeting has been scheduled in addition to the society's annual June meeting because of the accumulation of material resulting from the rapid growth of unclassified research in the atomic-energy field.

Authors desiring to present papers are requested to send titles and estimates of presentation time to Dr. L. D. P. King, Los Alamos Scientific Laboratory, Post Office Box 1663, Los Alamos, N.M., before *1 Oct.* Abstracts must be received by *1 Nov.*

Society Elections

■ Virginia Academy of Science: pres., Edward S. Harlow, American Tobacco Company Research Laboratory; pres.-elect, William G. Guy, William and Mary College; sec.-treas., Foley F. Smith, Virginia Academy of Science, P. O. Box 1420, Richmond. Representative to the AAAS Council is Foley F. Smith

■ American Institute of Mining, Metallurgical, and Petroleum Engineers: pres., Carl E. Reistle, Jr., Humble Oil and Refining Company, Houston, Tex.; pres.-elect, Grover J. Holt, Cleveland-Cliffs Iron Company, Ishpeming, Mich.; treas., Gail F. Moulton, Rockefeller Brothers, Inc., New York; sec., Ernest Kirkendall, AIME, New York, N.Y.

■ Society of Exploration Geophysicists: pres., Roy F. Bennett, Sohio Petroleum Company; v. pres., J. P. Woods, Atlantic Refining Company; sec.-treas., John C. Hollister, Colorado School of Mines, Golden.

Forthcoming Events

October

8. Science and Human Welfare, international conf., American Inst. of Geonomy and Natural Resources, Washington, D.C. (R. M. Field, AIGNR, South Duxbury, Mass.)

8–9. Shortage of Engineers and Scientists, conf., New York, N.Y. (E. S. Burdell, Cooper Union for the Advancement of Science and Art, Cooper Sq., New York 3.)

8–10. National Clay Conf., 5th, Urbana, Ill. (R. E. Grim, Univ. of Illinois, Urbana.)

8–12. American College of Surgeons, 42nd annual clinical cong., San Francisco, Calif. (ACS, 40 E. Erie St., Chicago 11, Ill.)

8–12. American Soc. of Clinical Pathologists, Chicago, Ill. (Indiana Univ. Medical Center, 1040–1232 W. Michigan St., Indianapolis.)

8–12. International Decennial Review Conf. on Tissue Culture, Woodstock, Vt. (P. R. White, Jackson Memorial Laboratory, Bar Harbor, Me.)

8–12. National Metal Cong., 38th annual, Cleveland, Ohio. (American Inst. of Mining, Metallurgical and Petroleum Engineers, 29 W. 39 St., New York 18.)

8–12. Pan-American Federation of Engineering Societies, 4th convention, Mexico, D.F., Mexico. (S. E. Reimel, Engineers Joint Council, 29 W. 39 St., New York 18.)

8–13. International Cancer Cytology Cong., Chicago, Ill. (A. H. Dearing, College of American Pathologists, Prudential Plaza, Chicago 1.)

9–10. Air Research and Development Command Science Symposium (classified), 4th annual, Boston, Mass. (Headquarters, ARDC, U.S. Air Force, P.O. Box 1395, Baltimore 3, Md.)

9–12. American Dietetic Assoc., 39th annual, Milwaukee, Wis. (Mrs. T. Pollen, ADA, 620 N. Michigan Ave., Chicago 11, Ill.)

9–15. World Medical Assoc., 10th general assembly, Havana, Cuba. (L. H. Bauer, WMA, 345 E. 46 St., New York, N.Y.)

10–18. Arid Zone Climatology with Special Reference to Microclimatology, international symposium, Melbourne and Canberra, Australia. (UNESCO, 19 Avenue Kléber, Paris 16e, France.)

11–12. International Scientific Radio Union, U.S. National Committee, Berkeley, Calif. (J. P. Hagen, 2101 Constitution Ave., NW, Washington 25.)

11–13. Indiana Acad. of Science, Bloomington. (W. A. Daily, Eli Lilly Research Laboratories, Indianapolis 6, Ind.)

14–17. Society of American Foresters, Memphis, Tenn. (H. Clepper, SAF, 17th and Pennsylvania Ave., NW, Washington 6.)

14–19. American Acad. of Ophthalmology and Otolaryngology, annual, Chicago, Ill. (W. L. Benedict, 100 First Ave. Bldg., Rochester, Minn.)

15–17. Assoc. of Official Agricultural Chemists, annual, Washington, D.C. (W. Horwitz, Box 540, Benjamin Franklin Station, Washington 4.)

15–17. Soil Conservation Soc. of America, Tulsa, Okla. (H. W. Pritchard, SCSA, 1016 Paramount Bldg., Des Moines, Iowa.)

15–18. American Veterinary Medical Assoc., annual, San Antonio, Tex. (J. G. Hardenbaugh, AVMA, 600 S. Michigan Ave., Chicago 5, Ill.)

15–19. American Soc. of Civil Engineeds, annual, Pittsburgh, Pa. (W. H. Wisely, ASCE, 33 W. 39 St., New York 18.)

15–26. New York Acad. of Medicine, annual graduate fortnight, New York, N.Y. (Secretary, Graduate Fortnight, NYAM, 2 E. 103 St., New York 29.)

16–17. Agricultural Research Inst., 5th annual, Washington, D.C. (L. Voris, National Acad. of Sciences, NRC Annex, Washington 25.)

16–17. National Acad. of Economics and Political Science, Washington, D.C. (D. P. Ray, George Washington Univ., Washington 6.)

16–18. Conference on Magnetism and Magnetic Materials, Boston, Mass. (T. O. Paine, Measurements Laboratory, General Electric Co., West Lynn, Mass.)

17–18. International Union of Therapeutics, cong., Paris, France. (A. Lemaire, 54, rue de Saxe, Paris 7.)

17–19. Symposium on Antibiotics, 4th annual, Washington, D.C. (H. Welch, Div. of Antibiotics, Food and Drug Administration, U.S. Dept. of Health, Education, and Welfare, Washington 25.)

18–19. Institute of Management Sciences, 3rd annual, Los Angeles, Calif. (C. M. Kelly, Litton Industries, Inc., 336 N. Foothill Rd., Beverly Hills, Calif.)

18–20. Optical Soc. of America, semiannual, Lake Placid, N.Y. (A. C. Hardy, Massachusetts Inst. of Technology, Cambridge 39.)

21–23. American College of Apothecaries, Dallas, Tex. (R. E. Abrams, Hamilton Court, 39th & Chestnut St., Philadelphia 4, Pa.)

21–27. Iberian-Latin American Cong. of Dermatology, 3rd, Mexico City, Mexico. (Centro Dermatológico Pascua, Calle Dr. Garciadiego 21, Mexico 7, D.F., Mexico.)

22–24. American Standards Assoc., 38th annual, New York, N.Y. (ASA, 70 E. 45 St., New York 17.)

22–25. American Soc. for Pharmacology and Experimental Therapeutics, Louisville, Ky. (H. Hodge, Dept. of Pharmacology, Univ. of Rochester, Rochester, N.Y.)

22–26. National Safety Cong., Chicago, Ill. (R. L. Forney, National Safety Council, 425 N. Michigan Ave., Chicago, 11.)

22–27. Endocrine Soc., 8th annual postgraduate assembly, Houston, Tex. (Office of Dean, Univ. of Texas, Postgraduate School of Medicine, Texas Medical Center, Houston 25.)

22–2. Industrial Forestry Seminar, New Haven, Conn. (E. T. F. Wohlenberg, Industrial Forestry Dept., Yale Univ., New Haven.)

23. American Soc. of Safety Engineers, annual, Chicago, Ill. (J. B. Johnson, ASSE, 425 N. Michigan Ave., Chicago 11.)

25–26. National Soc. of Professional Engineers, White Sulphur Springs, W.Va. (P. H. Robbins, 2029 K St., NW, Washington 6.)

26–29. American Heart Assoc., annual, scientific sessions, Cincinnati, Ohio. (Medical Director, AHA, 44 E. 23 St., New York 10.)

27. Eastern Psychiatric Research Assoc., New York, N.Y. (T. R. Robie, 676 Park Ave., East Orange, N.J.)

29–30. American Cancer Soc., scientific session, New York, N.Y. (ACS, Professional Education Section, 521 W. 57 St., New York 19.)

29–30. East Coast Conf. on Aeronautical and Navigational Electronics, 3rd annual, Baltimore, Md. (W. D. Crawford, Westinghouse Electric Corp., Air Arm Div., Friendship International Airport, Baltimore 27.)

29–31. Energy Resources Conf., Denver, Colo. (Energy Resources Conf., c/o Denver Chamber of Commerce, 1301 Welton St., Denver 4.)

29–1. Conference on Climatology sponsored by American Meteorological Soc., Asheville, N.C. (K. C. Spengler, 3 Joy St., Boston 8, Mass.)

29–1. Society of Exploration Geophysicists, annual, New Orleans, La. (G. A. Grimm, Tide Water Associated Oil Co., Box 2131, Midland, Tex.)

29–2. Convention on Ferrites, Institution of Electrical Engineers, London, England. (Secretary, IEE, Savoy Place, London, W.C.2.)

(See issue of 17 August for comprehensive list)

Equipment News

All inquiries concerning items listed here should be addressed to Science, *Room 604, 11 W. 42 St., New York 36, N.Y. Include the name(s) of the manufacturer(s) and the department number(s).*

■ ELECTROPHORESIS APPARATUS is designed for processing paper strips or starch blocks. Sagging of strips is prevented by a tension device that holds the paper taut throughout experiments. Electrodes are made of platinum, and electrolytic decomposition products are screened from buffer chambers. Large-scale preparative electrophoresis is carried on in a migration cell by replacing the paper-strip carrier with an adjustable starch tray. Voltages may be set at from 0 to 500 v. Ranges of 0 to 20 and 0 to 200 ma offer a wide calibration spread for small differences in current setting. (Laboratory Glass and Instruments Corp., Dept. S27)

■ TECHNICAL DATA on 15 infrared-transmitting materials that are suitable for use as optical elements in infrared equipment are available in a new brochure. (Servo Corp. of America, Dept. S24)

■ IMPEDANCE COMPARATOR compares complex impedances of any phase angle and indicates the difference in magnitude between the two components being compared and the phase-angle difference simultaneously. On the most sensitive ranges the differences can be determined to 0.01 percent and 0.0001 radians, respectively. The unit includes a calibrating voltage, and the internal oscillator provides frequencies from 100 cy/sec to 100 kcy/sec in decade steps. Meter voltages are available externally to operate recorders, remote indicators, or selecting devices. The range of impedances that can be compared is nominally from 2 ohm to 20 Mohm. Four independent ranges are provided for the impedance difference and the phase-angle difference. (General Radio Co., Dept. S26)

■ TWO-CHANNEL AUDIOMETER permits operator to conduct many types of hearing tests. Both attenuators, graduated in 1-db steps, are continuously variable. The 15-amp instrument provides inputs for psychogalvanic and delayed speech tests and has an octave-frequency range of from 125 to 8000-cy/sec. It includes 500 and 1000 cy/sec oscillators and provides for both manual and automatic pulsing of tones. (Bell Hearing Aid Co., Dept. S30)

■ TECHNICAL DATA on the properties and applications of rare earths and their oxides are given in a recently published bulletin. (St. Eloi Corp., Dept. S32)

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(a) **Physician** experienced in pharmaceutical field or with definite interest and training in pharmacology or biochemistry; serve as director of research and medical relations, pharmaceutical company; $17,500. (b) **Director, Medical Literature Department,** pharmaceutical company; physician with supervising experience in writing and editing; East. (c) **Assistant Director,** excellently equipped laboratories for scientific criminal investigation; Ph.D., training in physiology, pharmacology, human anatomy, pathology. (d) **Research Biochemist,** Ph.D., with evidence of capacity for original research; university research department; $5200–$5600; West. S9-1, Medical Bureau, Palmolive Building, Chicago. X

Research Laboratory Technician with background in biochemistry. Write Midwest Medical Research Foundation, 3241 Victor Place, Wichita 8, Kansas. X

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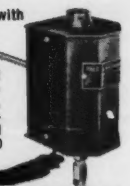

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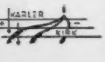

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123rd AAAS MEETING

New York City, December 26-31, 1956

The list of hotels and their rates and the reservation coupon below are for your convenience in making your hotel room reservation in New York. Please send your application, *not* to any hotel directly, but to the AAAS Housing Bureau in New York and thereby avoid delay and confusion. (Members of the American Astronomical Society who wish reservations at uptown hotels should correspond directly with the Hayden Planetarium.) The experienced Housing Bureau will make assignments promptly; a confirmation will be sent you in two weeks or less. **As in any city, single-bedded rooms may become scarce; double rooms for single occupancy cost more; for a lower rate, share a twin-bedded room with a colleague.** Most hotels will place comfortable rollaway beds in rooms or suites at 2.50 or 3.00 per night. Mail your application *now* to secure your first choice of desired accommodations. All requests for reservations must give a definite date and estimated hour of arrival, and also probable date of departure.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Rates for Rooms with Bath*

All hotels have sessions in their public rooms. For a list of headquarters of each participating society and section, please see *Science*, July 20, or *The Scientific Monthly* for August.

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Martinique	5.00– 9.00	8.00–14.00	8.00–14.00	16.00–38.00
New Yorker	7.00–10.00	10.00–14.00	11.50–17.00	25.00 and up
Sheraton-McAlpin	6.75– 9.75	9.75–12.75	10.75–13.75	20.00 and up
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TYPE OF ACCOMMODATION DESIRED

Single Room ..... Desired Rate ..... Maximum Rate .....

Double-Bedded Room ..... Desired Rate ..... Maximum Rate ..... Number in party .....

Twin-Bedded Room ..... Desired Rate ..... Maximum Rate .....

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(Attach list if this space is insufficient. The name and address of each person, including yourself, must be listed.)

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(Individual requesting reservation) (Please print or type)

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Mail this now to the Housing Bureau. **Rooms will be assigned and confirmed in order of receipt of reservation.**

GET YOUR ADVANCE COPY

of the General Program-Directory of the AAAS New York Meeting by first class mail – early in December

The General Program-Directory of the 123rd Meeting of the AAAS in New York City, Dec. 26–31, 1956, will be available to anyone, at cost, within the first week in December—whether he can attend the Meeting or not. You will want the General Program-Directory for your reference shelf.

Program content

1. The two-session general symposium, "Moving Frontiers of Science," arranged by the Committee on AAAS Meetings.
2. The six sessions of the Conference on Scientific and Technical Editorial Problems.
3. Details of the anniversary celebrations of the AAAS-Gordon Research Conferences, Botanical Society of America, Freud *et al.*
4. Programs of the 18 AAAS sections (symposia and contributed papers).
5. Programs of the more than 80 participating societies.
6. The Special Sessions: AAAS, Academy Conference, Conference on Scientific Manpower, National Geographic Society, Phi Beta Kappa, RESA, Sigma Xi.
7. Details of the Hotel Statler—center of the Meeting—and other hotels and session sites.
8. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
9. Exhibitors in the 1956 Annual Exposition of Science and Industry and descriptions of their exhibits.

Directory content

1. AAAS officers, staff, committees for 1956.
2. Complete roll of AAAS presidents and their fields.
3. The more than 265 affiliated organizations.
4. Historical sketch and organization of the Association; the 1955 revised Constitution and Bylaws.
5. Publications of the Association.
6. AAAS Awards and Grants—including all past winners.
7. Membership figures by sections.
8. Section committees (Council members) in detail.
9. Local committees.
10. Future Meetings of the AAAS through 1962.
11. New and current activities of the AAAS.

Advance Registration

Advance registration has these decided advantages: 1)You avoid delay at the Registration Center upon arrival; 2)You receive the General Program-Directory in ample time to decide, unhurriedly, which events and sessions you particularly wish to attend; 3)Your name is posted in the Visible Directory as the Meeting opens.

The following coupon may be used both by advance registrants and by those who wish only the advance copy of the General Program-Directory.

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1a. ☐ Enclosed is $3.00 for my advance Registration Fee which brings me the Program-Directory, Convention Badge, and all privileges of the Meeting.

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(Check one)

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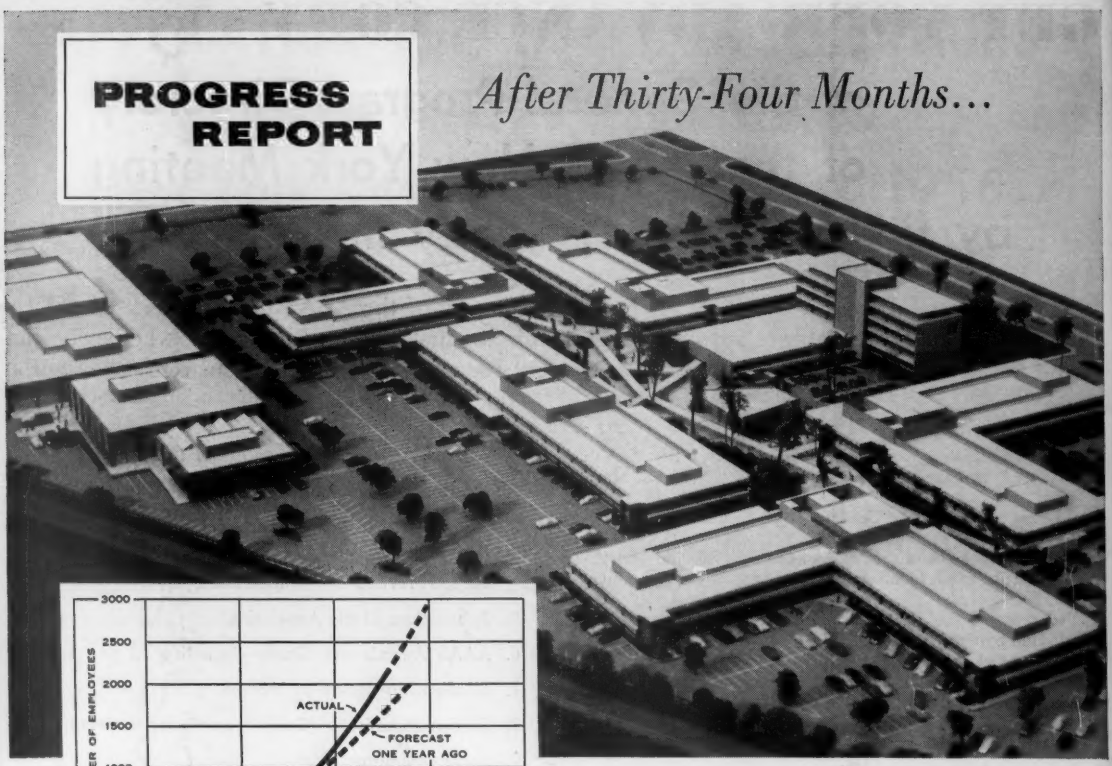
PROGRESS REPORT

After Thirty-Four Months...



RESEARCH AND DEVELOPMENT PERSONNEL The above curve shows the growth in Ramo-Wooldridge personnel which has taken place since our Progress Report one year ago. A significant aspect of this growth is the increase in our professional staff which today is made up of 135 Ph.D.'s, 200 M.S.'s and 265 B.S.'s or B.A.'s. Members of the staff average approximately ten years' experience.

FACILITIES Within the past few months, construction has been completed at our Arbor Vitae complex, which now consists of eight modern buildings of 350,000 square feet, four of which are illustrated at the bottom of the page. Nearby is the R-W flight test facility, including hangar, shop, and laboratories, located on a 7-acre plot at International Airport.

To provide additional space for our continuing growth, construction has been started on an entirely new 40-acre Research and Development Center, located three miles from the Arbor Vitae buildings. The photograph above is of a model of the Center, which we believe will be one of the finest research and development facilities in the country. The first three buildings, now under construction, will total 250,000 square feet.

A second major construction program is underway on a manufacturing plant for quantity production of electronic systems. The initial unit of the plant, located on a 640-acre site in suburban Denver, Colorado, will be completed next spring and will contain approximately 150,000 square feet.

PROJECTS Our current military contracts support a broad range of advanced work in the fields of modern communications, digital computing and data-processing, fire control systems, instrumentation and test equipment. In the guided missile field, Ramo-Wooldridge has technical direction and systems engineering responsibility for the Air Force Intercontinental and Intermediate Range Ballistic Missiles. Our commercial contracts are in the fields of operations research, automation, and data processing. All this development work is strengthened by a supporting program of basic electronic and aeronautical research.

THE FUTURE *As we look back on our first three years of corporate history, we find much to be grateful for. A wide variety of technically challenging contracts have come to us from the military services and from business and industry. We have been fortunate in the men and women who have chosen to join us in the adventure of building a company. We are especially happy about the six hundred scientists and engineers who have associated themselves with R-W. Their talents constitute the really essential ingredient of our operations. We plan to keep firmly in mind the fact that the continued success of The Ramo-Wooldridge Corporation depends on our maintaining an organizational pattern, a professional environment, and methods of operating the company that are unusually well suited to the special needs of the professional scientist and engineer.*

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